THE

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THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

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INTRODUCTORY.

The increasing taste for scientific study which nowadays manifests itself among all classes of readers, and the evident impossibility of any considerable number of them being able to spare the time necessary to examine the scores of journals and magazines devoted to its special branches and subjects, have given rise to the belief that a periodical consisting of a careful resumé of the most important inventions, discoveries and treatises of eminent, practical workers in the various departments of science and industry would be a convenience and of service to such persons, and might meet with sufficient encouragement to make it a success.

With this idea in view the first number of "The Western Review of Science and Industry" is offered to the public, and it is hoped that the foundation is thus laid for a publication which will long continue the exponent of the progress of practical knowledge and industry for this portion of the country.

As announced in our prospectus, this periodical will have for its object the popularizing of science, and will be devoted to the interests of the artisan, the mechanic, the farmer and the household, as well as of the more scientific reader. Very little space will be given to editorial speculations, or to advocating the theories of any man or class of writers, but it will rather be our aim to fill the pages of the "Review" with useful and practical information upon the subjects of mechanics and engineering, applied chemistry and metallurgy, geology, meteorology, archæology, agriculture and horticulture, materia medica, therapeutics and hygiene, domestic economy and scientific bibliography, derived from the best and most authentic sources, systematically arranged and presented in a plain and simple manner, so as to give actual and practical results in a form adapted to the wants and tastes of all classes of readers.

It is believed that such a journal will enable amateurs to keep pace in a general way with the advancement and progress made in most if not all of the departments of science, and that its practical suggestions and selections will be found of decided value to working people of all classes, whether in the laboratory, the workshop, the field or the dwelling house; and it is hoped that it may meet with a support commensurate with its merits, in which event no efforts will be spared to make it equal to any periodical of the kind in the country.

ARCHÆOLOGY.

The recent discoveries made by General Di Cesnola, in Cyprus, and Dr. Schliemann, in Asia Minor and Mycenæ, are attracting so much attention on account of their wonderful results and all absorbing interest, that we have concluded, at the risk of seeming to be behind the times, to give a summary of all that both have done up to the present time.

We also call attention to the very interesting contribution made by Judge West to the literature of mound building, in his report to the Kansas City Academy of Science of the explorations made by himself and his associates among the mounds of Clay County, Missouri, last fall.

DR. SCHLIEMANN'S DISCOVERIES AT MYCENÆ.

Dr. Henry Schliemann, who is now about fifty years of age, is described as being five feet nine inches in height, rather stout, with full, round, unshaven face, and wearing the air of and clothes of a successful merchant. He seems to have commenced life as as an employé in a German mercantile house, where he learned Italian from a fellow clerk, bought a grammar and taught himself Greek; became passionately fond of Homer and other ancient Greek authors; afterwards learned Russian and went to Russia and engaged in business, where he made a handsome fortune, which he subsequently increased to a princely sum in California.

Having always opposed the "Wolfian hypothesis" that the Homeric poems are simply made up of some sixteen or more rhapsodic songs, composed independently by a number of poets, transmitted from remote periods by memory and finally consolidated into a not very harmonious whole, Dr. Schliemann, upon finding himself in independent circumstances and possessed of a wife who shared his enthusiasm, determined by his own explorations, guided by Homer's own descriptions and those of some later writers, such as Pausanias and Herodotus, to prove that Homer himself was a real personage, and that his poems were based upon historical facts.

Commencing his excavations in Asia Minor, some three or four years ago, under a firman from the Turkish Government, he soon startled the scientific world by claiming to have discovered the remains of ancient Troy upon the heights now called Hassirlik. While this claim was never fully admitted by archæologists, he certainly made some most interesting and valuable discoveries, disinterring successively cities superimposed upon cities, and exhuming from their hidden recesses relics of ancient art extremely important in illustrating the customs and civilization of Greece in those early times. Before he had concluded his explorations and excavations, however, his firman from the Turkish Government expired, and official jealousy prevented his procuring its renewal. The results of his researches having been published, as well as a series of photographic pictures representing the treasures found by him, known as the Hassirlik Album, it is not necessary to give an extended account of them here.

Undiscouraged by his disappointment in Asia Minor, he obtained permission from the Greek Government, a few months ago, to make excavations at the site of Mycenæ, the town of Agamemnon, "King of Men," and the principal city of Greece at the time of the Trojan war. The work was commenced last spring, but until within the past few months attracted very little attention. Now, however, Dr. Schliemann's discoveries are regarded as among the most important of the nineteenth century, and, by many archæologists, as fully corroborative of his position that Homer was a reality, and his poems at least historical, if not exact history. Others still doubt, and await further developments and more minute and precise descriptions, accompanied by photographs of the objects of gold and bronze discovered, before giving their assent to the truthfulness and credibility of Dr. Schliemann's amazing story. At all events, he has discovered the tomb of a royal family, and even if it should prove not to be that of Agamemnon, its discovery throws much light upon the history, art and daily life of the ancient Greeks, while the remarkable agreement between Homer's description of their arms, utensils and accouterments and those actually found tends to shatter the "Wolfian hypothesis," and place the blind poet of Argos among the most reliable authors of the past.

The first extended report of these wonderful discoveries reached this country last fall and have been followed by several letters from Dr. Schliemann himself, the last of which was received by the London *Times*, in the latter part of December, 1876.

"In the northern corner of the Plain of Argos, at the base of two rocky mountains, one of which is 2,500 feet above the sea level, and whose summit is crowned by a small church dedicated to the Prophet Elias, is situated the celebrated Acropolis of Mycenæ. It stands on a triangular shaped rock 132 feet in height and about 1,200 feet square, and is surrounded by cyclopean walls from thirteen to forty feet in height. These walls are of three different styles of architecture, and were doubtless built in three different eras. One part is, like the walls of Tyrius, composed of large stones built upon small ones; another part composed of polygonal stones beautifully joined. The third style, situated near the Gate of Lions, is composed of large square blocks of stone built in horizontal lines. The lower city was situated to the south and southwest of the Acropolis, as is seen by the remains of the cyclopean walls, houses and a bridge, all cyclopean; also nine treasure houses, and by the fragments of beautifully painted ancient clay vases, with which the ground is literally covered. The position of the town being principally on precipitous hills, the accumulation of earth is but small; and does not exceed eighteen inches in depth.

Six of the treasure houses are shaped like furnaces, and are so called by the inhabitants to-day. Five of them, it appears, were excavated in ancient times; but the result was not, it is supposed, encouraging, as no attempt was ever made to open a sixth, which was above ground, and could easily have been excavated in a single day by a few workmen. Other two of these treasure houses were conical in form, like the well-known one of Atreus. One, situated near the Gate of Lions, is small, and was, it appears, excavated by the ancients. The one now being excavated seems to be nearly as large as the treasure house of Atreus. Seven or eight workmen were employed for about a fortnight before they succeeded in bringing to light the upper part of the triangular opening into it, and about 1,000 cubic feet of earth had been removed before beginning to excavate the treasure house itself. Twelve men were engaged for quite a fortnight in opening the entrance of the Acropolis through the Gate of Lions. It was blocked up by huge stones, which, it appears, were thrown down on to the Argives when they were besieging the Acropolis, 468 years B. C.. Such, at least, is the opinion of Dr. Schliemann. At once to the left, after entering the gate, a small room has been found, the roof of which is formed of a single large slab. It is so low one can hardly stand upright in it; though so small, it must have been used by the doorkeeper. No ancient author affirms that the ancient City of Mycenæ was inhabited after its capture by the Argives, when the inhabitants were driven away; but Dr. Schliemann is convinced that it was again peopled, and that there was a new city existing for a long time, probably for more than two centuries, because the surface of the ground to a thickness of three feet is full of the remains of a Greek age. This repeopling took place, according to Dr. Schliemann's ideas, early in the fourth century B. C., and he thinks it was again devastated in the second century B. C. This theory is supported by the fact that many coins of the Macedonian period have been found, and by the entire absence of the coins of the Roman epoch. The City of Mycenæ had no coinage of its own. Under the comparatively modern Greek city quantities of fragments of beautifully painted ancient vases have been found, painted both inside and outside, the inside painting, from the variety of the coloring and beauty of design, frequently far surpassing that of the outside. Some of the fragments have stags painted outside, and inside figures of men and women. Perfect vases have frequently been met with having two handles and a small pipe through which the liquids were poured in and out. All these painted vases were made on a potter's wheel, except very small ones, which were made by hand. Here were found, in August, more than 200 figures of Juno, some entire, others broken. They are of baked clay, and are formed either to represent a cow or a female with horns. Most of them are ornamented with bright red paintings, and the women are represented with full breasts, under which protrude long horns, which unite and form a semi-circle. There were also found twelve other figures of Juno, the bodies shaped like quoits, the heads uncovered and without horns; hair hanging down the baek in a plait; also, some figures with heads like birds, with large eyes and hands clasped on their breasts. A doll, about five and one-half inches high, representing a very ugly old woman, probably a priestess, was also found. Glass and iron were known to the Mycenæans in very ancient times, as at a depth of ten feet a pierced glass bead and many articles of a glass-like substance, something like buttons, were found; the latter were probably used to ornament doors, etc. In iron were found two daggers and two keys of very curious construction. One of the keys, about five inches in length, has at one end a copper ring for suspension; also, two well-preserved bronze knives, one of which has part of a bone handle; and two arrows with pyramidal points, resembling some Carthagenian arrows found by Dr. Schliemann while excavating in Sicily last year; also, five finely polished stone axes and a small but thick quoit of baked clay, with a deep grove around it, in which a string was tied to hang it up by. One side of this quoit is quite smooth and many symbols of holy fire, often met with in Troy, are graved on it. In the same place hundreds of spindles, nearly all made of beautiful blue stone, without any ornament, were found.

It appears that the Mycenæans were musicians, as fragments of a finely ornamented lyre and of a flute made of bone have been found; also, fragments of a crystal vase and a wooden comb. Very often are found smooth pieces of dry clay, with painted or graven ornaments, which were probably used to decorate the inner walls of houses.

At a depth of from ten to eleven and a half feet (sometimes at six and a half feet) cyclopean houses are discovered; they are built of rough stones, without lime or earth, and stand sometimes at a depth of twenty feet on the solid rock. More remarkable here than even at Tyrius are the aqueducts. There they are cut in the natural rock, while here they are built on the ground. They are of stones, roughly hewn, and without lime. It is impossible to conceive how the water ran along without escaping through the crevices.

Still further on have been found many graves, as seen by the large slabs of limestone which mark each tomb. Some of these tablets are plain, others have anaglyphs of priceless value to the archæologist. A remarkable one has carved in the centre a warrior, lance in hand, standing on a chariot drawn by a horse, whose widely-extended legs show his great speed; the wheels of the chariot have four spokes, forming a cross; below is seen a stag pursued by a dog; on either side are very strange ornaments, having probably a symbolical meaning. On another slab there is also a warrior standing on a chariot; in his left hand he holds a broadsword, in his right a long lance, which is piercing the neck of a fantastic wild animal which is running very quickly, and much resembles the lions on the gate. The difference is that this beast has horns and his tail erect; but as the lions' heads are wanting, who knows if they were not also horned? In front of the animal stands a man with a large knife; with his left hand he holds the right horn of the beast, which partly conceals the horse in the chariot. Behind the chariot is a curious device, and another above the beast. Probably these, also, have symbolical meanings. Above the anaglyph there are exquisite ornaments, consisting of spiral lines. Each tablet is about four feet square and six inches thick.

After very minute examination of this anaglyph, Dr. Schliemann observes that the appearance of all the animals, especially the formation of the beast with horns, so much resembles the style of sculpture of the two lions that he is convinced they belong to the same period—that is to say, 1200 B. C. Probably all the treasure houses of Mycenæ and the portion of cyclopean walls on either side of the Gate of Lions, as well as the gate itself, are of the same period. Homer repeatedly calls Mycenæ the "Golden City." Its great wealth is certainly confirmed by its numerous treasure houses, and by the splendor of its architecture; but the great question arises how this city, in the most remote period of antiquity, when commerce did not exist, acquired its enormous quantities of gold. It certainly appears that the Mycenæans could only have gained their wealth by piratical expeditions to the coasts of Asia.

In the great trench, which is near the Gate of Lions, the excavators have brought to light three rows of tombs, inclosed by a slim circular wall extending to a neighboring rock. These tombs are made of limestone, and are very near each other; they are from thirteen to sixteen feet deep. By the side of them were discovered two lines of monumental tablets, of which three in one line and four in the other stand upright. One of them is divided into two parts, and has sculptured on it a man in a chariot, drawn by one horse, whose great speed is shown by the position of his legs and tail, which stands erect. Behind the chariot is the handle of a spear. By the side of the horse is a second man, standing upright, with an entirely unknown weapon in his hand. On either side of the chariot are carved in a circle regular spiral ornaments. Another sepulchral tablet is ornamented with carvings representing serpents, whose spiral coils form magnificent ornaments. In the same row of tablets there are pieces of three others. The sculptures on them represent men and horses, A little further on a roofless cyclopean house has been found. In excavating it a great quantity of ashes and thousands of pieces of antique painted vases were brought to light, as well as quantities of plumb line weights, having handles on both sides for suspension, and a small quantity of charred wheat; also numerous spindles made of blue stone. On one of the vases is a very curious painting. It represents two swans, their heads close together, delineating in a manner the Russian crown. In addition to all these above mentioned tombs, others have been discovered of a very peculiar shape, about three feet deep and from six to eight feet wide, and made of small flags. The articles found in them are pieces of vases and bones. It may be affirmed for a certainty that all the bones are those of animals, because among them are many cheek bones of swine. From the absence of other articles Dr. Schliemann conjectures that in a more remote period the tombs were pillaged and filled up again.

The discovery of tombs on the virgin soil near the Gate of Lions, on the most celebrated part of the Acropolis, where one expected to find the palace of Agamemnon, makes it clear that these tombs are those of illustrious men. Pausanias, speaking of Mycenæ, says: "Clytemnestra was buried, and Ægisthus, a little further on, outside the walls; inside, where Agamemnon and those who died with him were buried, they were not considered worthy to be interred." Of course, says Dr. Schliemann, what Pausanias says about the tombs he had not himself seen, but learned it from tradition. When he visited Mycenæ, 170 years after Christ, they had been for centuries buried under the debris of prehistoric ruins on which the Greek city had been built, and which was itself destroyed four centuries before Pausanias lived. There were also found a large piece of porphyry with splendid reliefs, representing among other things three roses; and another piece of almost similar stone, with beautiful serpentine ornaments, similar to those taken out of the treasury of Atreus, which are now in the British Museum.

In excavating the treasure house of Clytemnestra (so-called), near the Acropolis, many figures of Juno were found. Some have extended hands, others have them clasped on the breast. Also some female figures, with large eyes and outstretched hands. On each side of the breasts horns protrude, and, uniting, form a circle. Also male figures, with uncovered heads, ornamented by a diadem with a star. The figures have large Asiatic noses, large eyes, and Assyrian beards. Many figures of Juno, in form like a cow, are also found, decorated with paintings in red and blue. All these were found in a trench in front of treasure houses. In the Acropolis figures of Juno were found in such abundance that more than seven hundred have been collected. There also have been discovered many figures the centres of whose bodies form quoits, and represent the full moon. As Juno was at first the goddess of the moon, the horns of the cow represent the crescent moon. There are also figures with uncovered heads, bird-shaped. Others with heads much compressed, and having on them a kind of flat dish or plate, on which a cross is sometimes painted. Figures of females with cows' heads are frequently met with, but these until the present time (November 21) have been seen only on handles of vases. Curiously enough these pictures of figures with cows' heads were found in Troy on vase handles only. We have also a bone button, with thin gold covering, in the middle of which is graven a circle, with a triangle made by three long, broad knives, their handles composed of beautiful spiral lines. That gold and silver were in use is proved by the fact that a piece of porphyry has been found on both sides of which are cut fifteen different patterns of ornaments, such as earrings, brooches, etc., which ornaments, there is no doubt, were always made of gold or silver. There have also been found, at a depth of about five metres, numerous copper articles, among them five large knives, two small wheels, two lances, two battle-axes, a pair of tongs, two vases and pieces of four others. Also many pieces of agate, with pictures of animals delicately engraved on them; they have holes through them, and were probably used for necklaces. Most wonderful are the variety of the paintings on the vases. The greater part of them are painted inside and outside, the inside paintings being usually much the finer.

Up to this date (November 21) only three small inscriptions have been discovered. One is on both sides of a figure of Juno; another on an earthen figure of a cow; the third is on a small quoit. The letters, Dr. Schliemann believes, are quite unknown. There are also very curious cups, in shape like a claret glass, with sometimes only one, sometimes two handles. In no part of the Acropolis is the accumulation of earth more than eight metres. This depth is only reached near the great surrounding wall. The quarry from which the stones for the great cyclopean walls were taken has been found in the village of Charvati, half an hour's distance from the Acropolis.

The excavation of the supposed treasure house of Clytemnestra would have been finished much more quickly had it not been impeded by the huge stones which appear to have fallen in from the roof. Dr. Schliemann thinks that the inner walls of this treasure house were never ornamented by brass slabs, as were those of the treasure house of Atreus and that of Minyas, in Orchonenus. This one (at Mycenæ) is simpler, and appears much more ancient than the other two. The entrance is five metres long and eight wide; the roof consists of four slabs, each six metres in length. From some marks on the walls it appears that there was, on either side of the entrance, a square pillar, and fragments of a spiral ornament are seen on the slab over the entrance. Some divisions on the stones, forming a triangle above the entrance, show that there must, at some time, have been a triangular anaglyph, similar to the one on the gate of the Acropolis at Mylanda. The builders left these triangular spaces above the entrances either to lessen the weight which rests on the slabs of the roof or to place there some triangular anaglyph to decorate the entrance. Among the various articles which have been found inside the treasure house itself, the most curious are some horsemen, very roughly made of baked clay. They are holding with both hands the manes of the horses. They resemble those made in earth found in Bœotia. Most of the vases are covered with the meanderings of the Greek scroll and with spiral or serpentine lines. Among the pottery found in the treasury were part of a necklace with a large bead of white glass, two beads of transparent light-blue stone, and two others of a reddish blue stone. They have each a hole through and are strung on fine copper wire.

In the Acropolis, near the gate of Lions, under the ruins of a Greek building, have been brought to light a labyrinth of cyclopean walls, forming many passages one or two meters wide. They are filled with small stones and earth. In many parts the plaster on the walls is still preserved. There have been found here three arrows, with points in shape like a small pyramid. Dr. Schliemann's opinion that the double parallel rows of large slabs form an entire wall has been found correct. The half of this row of slabs has been strengthened by a small wall built for the purpose, the other half is erected on the highest rock. It is believed that each slab marks the site of some tomb, and that the space between the parallel rows of slabs has been used, perhaps, as the place where drink offerings were presented, or to plant flowers in honor of the dead. In this space also very curious articles were discovered, such as a wooden fish, a stick handle made of green stone, with a human face coarsely carved on it. The face has a very wide nose and mouth, and wears a necklace. It is quite of an Egyptian type. Further on an image of Juno, in form like a standing cow without horns, hair dressed as a woman's, and a hole in the neck to suspend the image by. There is also a figure with two feet in place of the customary pipe, with a birds head, very large eyes, hands outstretched and wearing a necklace. The hair is marked on back of the head; the dress is colored red. Also, an uncolored doll, a male, with large eyes, a large hooked nose, no mouth, the head covered with a kind of cap like a Turkish turban. Another very original figure, with bare head, like a bird's in shape, but with two ears; hands on breast—not crossed; the head turned upward. The artist evidently intended to represent the goddess praying. There are also two daggers, two arrows of glass, and many glass beads from a necklace. Also, a small quoit, of a black glassy substance, with an ornament representing a fly, with holes on both sides for suspension.

To the south of the double row of tombs, the excavators have brought to light a large cyclopean house. It contains two rooms and four passages a metre wide; the walls still show in many parts the remains of the clay which was spread over them, as we use plaster. The largest room is five metres long by four wide. The articles found in the house proved that the inhabitants were acquainted with luxury. In one room, at a depth of six metres, has been found a ring of white onyx, having an intaglio representing two animals without horns, which at first sight appear to be deer, but, after a strict examination, it is clear that the workman intended to represent cows. Both the animals have their heads turned toward their calves, in the act of sucking. Although the workmanship is very ancient, the anatomy of the animals is splendid, quite a masterpiece of art. One wonders how such work was possible without the aid of a microscope. Round pieces of agate, with holes through them, have been found. They are engraved with spiral ornaments representing horses; also, there is a mould of black stone, having in its six sides other moulds cut, in which were cast the black glass, conical-shaped articles, which are so frequently found; each of these small cones is ornanented with spiral lines, and is pierced for suspension. In addition to these varieties there have also been found some axes made of hard black or green stone, many spindles of blue stone, and numerous vases; among the most curious are some having two or three handles, representing crocodiles. All these vases are covered with paintings of a dark red color, representing warriors, who wear breastplates and greaves; their dogs have bristles like the porcupine or hedgehog; in their helmets they have long plumes, and from the front of the helmets projects a round horn. The warriors are always armed with circular shields, the lower part of them cut like a half moon, and with lances from which protrude Trojan figures; their faces are of a very ancient type, haveing long noses and Assyrian beards. There are also other vases, having for ornaments painted circles in which are many lines or marks, which may be letters. In the cyclopean house two brass boilers have been discovered, one of which has three feet, like a tripod.

Last week great good fortune crowned the labors of the excavators at Mycenæ. On Thursday they began to find many golden and other invaluable fragments of antiquity. Inside the inclosure, at a depth of nine metres from the surface, was discovered an inestimable archæological treasure, which excites the wonder of all. On Saturday the discoveries were still more astounding. Up to yesterday two square holes have been opened (tombs they are supposed to be). The bottoms of them are covered with pebbles, on which were found burnt bones and ashes, and on them again many golden vessels, ornaments, etc. The most important are the following: Small silver bronzed head of cow, with curved horns of pure gold, ending in points, and as thick as a good-sized finger; the mouth is gilt. This head is truly a masterpiece, and quite perfect. As, however, the face is still covered with earth and rust, it is not clear if it really is a cow. Dr. Schliemann believes it is, though other archæologists, who are also there, question it. If it is a cow it is said to be a mythological representation of Io or Juno. Up to this date more than one hundred and seventy gold buttons larger than a farthing have been found, also many bone buttons, surrounded with gold, and sixteen larger golden ones, about the size of a penny; sixteen copper two-edged swords and a gold sword-handle, beautifully worked; a small lance; a belt, probably for sword, entire, and finely wrought, length over a metre and about three inches broad. Some copper boilers have also come to light. Of infinite value and interest are three or four small square plates of gold of most exquisite workmanship, with lions engraved on them. The most beautiful of them has engraved on it Hercules struggling bravely with an enraged upright lion. It is in a good state of preservation. These plates were probably used for a necklace. There is also one silver cup and three of pure gold of great weight. One has one handle, the others two. The handles on one of them are beautifully wrought pigeons, and it is ornamented on the outside with a spirited anaglyph of stars as large as a dollar. All present were astounded when a skull covered with a piece of gold leaf was brought to light. There also were many pieces of gold leaf, with beautiful ornaments on them; a cross is frequently found depicted on them. There are two sceptres, with splendid crystal handles; some pieces of gold the size of a dollar, many of them beautifully ornamented; some gold earrings and an engraved precious stone of a reddish tint, as large as a fine almond, together with many other ornaments of smaller value, but not a single inscription or coin. The weight of all the golden articles yet found amounts to over nineteen pounds. Their archæological value is inestimable, because Dr. Schliemann states that no golden Greek antiquities prior to the Macedonian period exist in any museum in Europe."

On November 28th, 1876, Dr. Schliemann sent the following enthusiastic dispatch to the King of Greece, announcing his discoveries:

"To His Majesty King George: With unbounded joy I announce to your Majesty that I have discovered the monuments which the tradition related by Pausanias indicates as the tombs of Agamemnon, Cassandra, Eurymedon, and their companions who were killed while feasting at a banquet by Clytemnestra and her lover Ægisthus.

"These tombs are surrounded by a double parallel circle, with tablets undoubtedly erected in honor of the victims. In these tombs I have found immense archæological treasures and numbers of articles of pure gold.

"The treasure alone is sufficient to fill a large museum, and the most splendid in the world. In succeeding ages I am sure it will attract to Greece thousands of strangers from abroad. As I am laboring simply for the love of science I waive all claim to the treasure and offer it, with intense enthusiasm, entirely to Greece.

"Sire, may these treasures, with God's blessing, become the corner stone of immense national wealth. DR. HENRI SCHLIEMANN.

"Mycenæ, November 28, 1876."

Dr. Schliemann writes, under date Mycenæ, December 2, 1876:

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"Already, while engaged in the excavation of the large fourth tomb, the results of which I have described in my last two letters, I explored the fifth and last sepulchre, which is immediately to the northwest of it, and which had been marked by the large slab, with the bas relief of two serpents, and by an unsculptured tombstone, both of which were eleven and two-thirds feet below the surface of the mount, as it was when I began the excavations. At a depth of ten feet below the tombstone, or of twenty.one feet eight inches below the former surface, I found two evidently much older unsculptured tombstones, and only three feet four inches below these I found a tomb eleven and a half feet long, nine feet eight inches broad, which had been cut out in the calcareous rock to a depth of only two feet, so that its bottom is twenty-seven feet below the former surface of the mount. In variance with the other tombs, the four inner sides of this sepulchre were not lined with any walls; but, as usual, the bottom was strewn with a layer of pebble stones. On this I found the mortal remains of only one person, who, like all the other bodies, had been burnt on the precise spot where it lay. This was proved as well by the calcined pebbles below and around the corpse as by the undisturbed masses of ashes with which it was covered, and, finally, by the marks of the funeral fire on the rock walls. Around the skull of the body, which was unfortunately too fragile to be saved, was a golden diadem, with impressed ornaments, representing in the midst two suns, the remaining space being filled up with spiral ornaments. On the right side of the body I found a lance-head, with a ring on either side; further, two small bronze swords and two long knives of the same metal; on its left was found a golden drinking cup, with one handle, the ornamentation of which represents two horizontal rows of fish-spines and one row of arrow-heads. With the swords were found many small rags of beautifully woven linen, which doubtless belonged to the sheaths of these weapons. In the same tomb was found a six and a half inch high, hand-made, light green vase, ornamented with two rows each of three protruding humps; further, a light red vase, ornamented with black spiral lines, and with two female breasts surrounded by circles of black strokes.

"The three bodies of this tomb lay with their heads to the east and their feet to the west; all three were of gigantic proportions, and appeared to have been squeezed with force into the small space of only six feet, which was left for them between the aforesaid walls; the bones of the legs, which are nearly uninjured, are really of enormous size. Although the head of the first man was covered with a heavy golden mask, his skull crumbled away on being exposed to the air, and but few bones could be saved besides those of the legs. The same was the case with the second body, which had been plundered in antiquity. But of the third body, which lay at the north end of the tomb, the round face with its flesh had been wonderfully preserved under its ponderous golden mask; there was no vestige of hair, but both eyes were perfectly visible, also the mouth, which, by the enormous weight that had been pressing upon it, was wide open and showed thirty-two beautiful teeth. By these all the physicians who came to see the body were led to believe that the man must have died at the early age of thirty-five. The nose was entirely gone. The body having been too long for the space between the two inner walls of the tomb, the head had been pressed in such a way on the breast that the upper part of the shoulders was nearly in a horizontal line with the vertex of the head. In spite of the large golden breastplate, so little had been preserved of the breast that the inner side of the spine was visible in many places. In its squeezed and mutilated state the body measured only two feet four and a half inches from the top of the head to the beginning of the loins; the breadth of the shoulders did not exceed one foot one inch, and the breadth of the stomach one foot three inches; but the gigantic thigh bones could leave no doubt regarding the real proportions of the body. Such had been the pressure of the rubbish and stones that the body had been reduced to the thickness of one inch to one and a half inches. The color of the corpse resembled very much that of an Egyptian mummy. The front of the man was ornamented with a plain round leaf of gold, and a still larger one was lying on the right eye; I further observed a large and a small gold leaf on the breast, below the large golden breast cover."

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Dr. Schliemann resumes his narrative under date December 3d:

"The now nearly mummified body was decorated with a four foot long by one and three-fourths inch broad golden shoulder belt, which, by some cause or another, was not in its place, for it now lay across the loins of the corpse, and extended in a straight line far to the right of it; in its midst is suspended and firmly attached, a small bronze sword, on which is soldered a beautifully polished, perforated object of rock-crystal in form of a jar with two silver handles. It is pierced in its entire length by a silver pin. With it was found a small object of rock-crystal in form of a funnel, with four concave sides. To the right and left of the body lay long bronze swords; to the left was also a long bronze knife. All these weapons had probably been suspended on a belt of embroidered work, which had disappeared. The sheaths of the swords had been of wood, much debris of which remained. All the sheaths had been gilded, and had in their entire length been adorned with round buttons of gold, which showed many different sorts of magnificently engraved spiral lines. The handles of the swords were plated with gold and covered with splendid engravings. Instead of the large wood and alabaster buttons of the handles, the sword-handles of this body seem to have had at their extremity richly ornamented golden plates, ten of which were found close to it. Each of them is three and four-fifths inches long and one and three-fifths inches broad, and every one of them represents a large cow head, with long horns and immense eyes; further, a lion pursuing a stag with such velocity that his four legs are in the same horizontal line with the body; the stag, though still running at full speed, feels that he is lost, turns his head toward his merciless pursuer and looks at him full of anguish. To the reverse side of these wonderful plates still sticks a good deal of blackish matter, perhaps a sort of lime, which may have served, I do not know how, to fasten them to the handles. Two plates must necessarily have been required for each handle. To the bronze sword on the right of the body was attached a nine and three-fifths inch long golden tassel. The massive golden mask which covered the head of this body, and which I mentioned in my last letter, is twelve and two-thirds inches long and twelve and a half inches broad. It is so thick that the enormous weight, which for ages has been pressing upon it, has made no impression on it. It shows a round face, with large eyes and a large mouth, much resembling the features of the body when first uncovered, and I feel now more convinced than ever that all the golden masks faithfully represent the features which they cover. In fact, a single glance on these splendidly-made masks must convince every one that they are real portraits and not ideal types.

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"I think it necessary to add that the metal of the Mycenæan weapons, kettles, etc., may either be pure copper or bronze, for the analysis has not yet been made.

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"My last letter was of the 7th inst., and I have continued the excavations ever since with the utmost vigor, employing constantly 125 laborers and five horse carts. In the treasury the difficulties were far greater than I anticipated, particularly as the delegate of the Greek government opposed the removal of the foundations of a Hellenic house just above the lower part of the 'dromos.' Thus I have been unable to clear the latter of the rubbish, nine feet deep, which still covers its pavement, and have only succeeded in clearing out the 13-foot long and 8-foot broad passage of the entrance, and the central part of the treasury, comprising a space of 360 square feet, around which I leave a 9-foot high and 10 foot thick border of huge stones and rubbish. As soon as the Greek government consents to the removal of the aforesaid ruins, which have not the slightest value to science, I shall at once do the remainder of the work, but certainly not sooner. The two columns, to the right and left of the entrance, were not quadrangular, as I supposed, but fluted half columns, one of which—4 feet 3 inches high and 1 foot 4 inches broad—was found in the passage near the door. At 9½ feet before the latter, the 'dromos' is shut up by a five feet high wall of square calcareous stones. The door of the treasury has the enormous height of eighteen feet five inches, and is eight feet four inches broad. On the threshold, which consists of a very fine calcareous stone, and is two feet five inches broad, I found a very thin round leaf of gold. The floor of the treasury was covered with a coating of sand and chalk, traces of which are visible in many places; it slopes toward the center, which is one foot below the threshold. There was found in the treasury a large fragment of a frieze of blue marble, with an ornamentation representing a circle and a row of fish spines; further, five blades of bronze, $5\frac{1}{2}$ to $6\frac{1}{2}$ inches long, and a Juno idol, of the usual form, with two horns.

"In the Acropolis I have entirely cleared out the passage south of the Lions'Gate, and brought to light the enormous threshold of the latter, which consists of a fifteen-foot long, eight-foot broad, very hard calcareous block. The ruts caused by chariot wheels, of which all guide books speak, exist in the imagination of enthusiastic travelers only, but not in reality. The different monuments which I have brought to light in close proximity to the Lions' Gate, such as the immense double parallel row of closely joined slabs, the gigantic sepulchers, etc., have, since a very remote antiquity, barred the access of chariots to the Acropolis. No doubt, the fifteen small, straight, parallel furrows, which are cut all along the threshold, have been mistaken for ruts of chariots. The opening of the gateway widens from the top downward. It is $10\frac{2}{3}$ feet high, and the width of the door is $9\frac{1}{2}$ feet at the top and $10\frac{1}{4}$ feet below. In the 15-foot long and 8-foot broad lintel, are the 6-inch deep holes for the hinges, and in the two uprights, which it covers, are four quadrangular holes for the bolts or bars. There is a 1-foot 3-inch long and 1-foot broad quadrangular hole in the midst of the threshold, where the two wings of the gate joined. The threshold further shows, on its east side, a 1-foot broad artificially cut straight furrow, and on its west side another, which forms a curve; both seem to have served as channels for the rain water, the rush of which must have been great, the threshold being lower than the rock of the passage, which gradually rises. In the side of the threshold which faces the north is a long artificial hole of a peculiar form, which, in some way or other, must have been connected with the gate, for a cutting of precisely the same form exists in the large flat stone in the midst of the Scæan Gate at Troy. On the suffix of the gate stands a triangular slab of gray calcareous stone, 10 feet high 12 feet long and 2 feet thick, upon the face of which are represented in high relief two animals, hitherto thought to be lions, standing on their long-stretched hind legs, and resting with their paws on either side of an altar, in the midst of which is a column, which becomes broader toward the top, and has a capital ornamented with four circles, enclosed between two horizontal fillets. This ornamentation is peculiar to Mycenæ. The general belief that the heads of the two animals are broken off is wrong, for on close examination I find that they were not cut out of the same stone together with the animals, but that they were made separately and fastened on them with bolts; most probably they were of bronze and gilded. The straight cuts and the borings in the necks of the animals leave no doubt that they were put in separately. Owing to the narrowness of the space the heads must have been exceedingly small, and must have been facing the spectator. As stated in my first letter from Mycenæ, the great resemblance of the horned animal in one of the bas-reliefs in the Acropolis to the animals on the gate makes me believe that the latter were also fantastical animals with horns. At a distance of $11\frac{1}{2}$ feet from the threshold is, on either side of the passage, as in Troy, a quadrangular cyclopean masonry, two feet broad and high, and three feet long, which marks the site of a second gate of wood.

"At a few yards from the second gate I have brought to light a very curious cyclopean water conduit, leading into one of the two long and narrow cyclopean reservoirs which I had at first thought to be corridors. There is another cyclopean water conduit and another cistern immediately south of them. Both these water conduits have doubtless brought the water from the copious fountain called 'Perseia' by Pausanias, which is not, as he erroneously mentions, in the Acropolis itself, but at a distance of half a mile east of it. Its name seems to be derived from Perseus, the founder of Mycenæ. In clearing out the 13.20-feet deep masses of rubbish which obstructed the passage of the gate, I found a well preserved bronze sealing ring, on which are engraved two young women of marvellous beauty, which seems still to be increased by their simple and graceful hair dress. Both sit close together, but their heads are turned in opposite directions. The anatomy is well observed. There were besides found a large number of Juno-idols in cow or horned-female form, and a cow idol, showing, on a light yellow dead color, a number of dark red signs, which may be letters; also, large quantities of melted lead; further, a very primitive golden earring, consisting of a quadrangular golden wire twice turned round. The same form of ear-rings occurs also in the first of the four pre-historic cities at Troy, with the only difference that the wire there is round. There were also found here on the virgin soil a great many fragments of hand-made vases, having either inside and outside a plain, lustrous black or red, or a light green color, with black spiral ornaments. At only six feet behind the cyclopean wall, on the east side of the passage, I have brought to light an evidently much more ancient wall of huge blocks.

"The circular parallel double row of large slabs, which I have repeatedly referred to in my former letters, had originally been covered with cross slabs, of which a small number are still *in situ;* they are solidly fitted in and consolidated by one and a quarter to one and a half inches deep and four inches broad cuttings. As these latter exist on all the slabs, there can be no doubt that the whole circle was primitively covered in the same way. The slabs are from four feet two inches to eight feet two inches long, and one foot eight inches to four feet broad, and the largest are in the two places where the double row descends from the rock to the wall. Inside is at first a layer of large stones one foot four inches thick, for the purpose of holding the slabs in their position; the remaining space is filled up with pure earth mixed with long, thin nails in the places where the original covering remains in its position, or with household remains, mixed with innumerable fragments of archaic pottery wherever the covering is missing. This circumstance can leave no doubt that the cross slabs were removed in a remote antiquity, and it gives at the same time some idea as to the age of the double circle of slabs.

"In continuing the excavation on the north side of the cyclopean house, I brought to light two more chambers of it, and found there, at a depth of sixteen and one-half feet, three splendidly incised, perforated, round agates of a necklace, the one representing a cow head with very long horns, the other two horses standing against each other on their hind legs and turning their heads toward the spectator, just as the two animals on the sculpture above the gate must have done. Above the two horses on the agate is engraved a man with a Phrygian cap and a young woman with an uncovered head. The third agate is of a transparent red color and represents a stag, which appears to move with great velocity, although its head is turned backward. There were also found Juno-idols of a new form—e. g., a perfectly flat cow with only one big hind leg and two forelegs; a female idol with a very compressed bird's face, and with a Phrygian cap, instead of usual 'polos;' and, finally, a headless idol with all the characteristics of a woman, but with two long cow horns. There was likewise found a terra cotta cow horn three and a half inches long, which shows that there must have been much larger idols than those hitherto found. There were further found a number of small terra cotta tripods, in form of arm-chairs, cradles—in two instances even cradles with a child in them; all are gay-colored, and must have served as offerings; further, two perforated parallelopipeds of variegated color, four inches long, the use of which I can not explain. Among the findings I may further mention a comb of bone, and six perforated, round, flat, transparent white pieces of stone of a necklace, a door button of alabaster, and a large fragment of a bas-relief representing a man with a line, probably a bridle, in the hand; he was, no doubt, represented standing on a chariot, and resembles very much the man who holds the horns of the fantastic animal in one of the bas-reliefs described in my first letter from here. HENRY SCHLIEMANN."

This brings us to the latest reports that have been made by Dr. Schliemann upon his discoveries, which are regarded by the highest scientific authorities in London as the most important yet made in the history of archæological investigation, carrying us back beyond historic times, and to a great extent overturning the theory of several modern writers on history.

THE MISSOURI MOUND BUILDERS.

A PAPER READ BY JUDGE E. P. WEST BEFORE THE KANSAS CITY ACADEMY OF SCIENCE.

GENTLEMEN: Some of you, no doubt, will remember that I stated in a paper which I had the honor of reading before the Academy of Science, at its meeting in September last, that I had reason to believe that there were numerous artificial mounds in the vicinity of Kansas City, rich in palœntological remains. In this, upon investigation, my expectations in some respects have been more than realized, while in other respects the results have not been what I anticipated, but are, perhaps, none the less important in an ethnological point of view.

From Mr. Keller's farm, overlooking a branch of Line Creek, in Clay County, to Line Creek in Platte County, a distance of about three-fourths of a mile, I have located as many as twenty-five mounds. I have seen others east of Mr. Keller's, extending as far as Randolph, and I am informed by reliable gentlemen that they are seen west of Line Creek. On the south side of the Missouri River, I have located other mounds, in the vicinity of Rock Creek, in Jackson County; but whether erected by the same people remains to be determined upon further investigation.

In shape, the mounds examined represent the frustum of a cone, and vary in size from forty to eighty feet in diameter at the base, and from eighteen to thirty-five feet at the superior plane. They are found situated on the highest points, those commanding the finest views along the summit of the bluffs overlooking the Missouri River, and with a few exceptions are arranged in groups of from three to five. Those on the left bank of the river nearly all contain buried chambers or vaults, built of stone, compactly and regularly laid, quadrangular on the inside and circular on the outside. The stones, which are undressed, on the inside are laid horizontally, and apparently have been selected with great care, the walls presenting, when the earth is removed, a smooth inner face.

The chambers, as far as opened, are nearly uniform in size and construction, being eight and one-half by eight and one-half feet, with the exception of one, which is seven and one-half by eight feet, internal linear surface, and are from three and one-half to four feet in vertical height. In the center of the south wall of each chamber is an opening, or doorway, two and one-half feet wide. They are situated due north and south, with one exception, which varies but ten degrees from a north and south line. The walls are about eighteen inches in thickness at the summit, and slope outward and downward to about five feet at the base, at the medial line of the square.

Assisted by Drs. Fee, Halley and Smith, and Messrs. Winner, Lykins, Child, Michener, Traber and McDonald, of the Academy, and Messrs. Evans, Campbell and other gentlemen of the neighborhood, I have opened five of the mounds, which are situated on the land of Mr. Peter Brenner, to whom, and to Mr. Krouse and Mr. Klamm, and other gentlemen of the neighborhood, I am indebted for many acts of kindness and for material assistance in the prosecution of my work.

Those opened I have designated the five mound group. They are in Platte County, about sixty feet west of the line dividing that county from Clay County, and are all embraced within an area of two hundred feet. I have, for convenience of description, numbered them respectively from one to five, beginning on the east.

Number one, the most easterly of the group, contains a stone chamber seven and a half by eight feet, internal linear surface, and three feet in perpendicular height, with a doorway two and a half feet wide in the centre of the south wall. Within the chamber, and on the plane of the base of the wall, five human crania and other human bones were found. Two of the crania were on the west side, two on the east side, and one near the centre. Those on the west lay on their sides, and near the west wall, facing the wall, and facing each other, and are comparatively in a good state of preservation. These two crania I have the pleasure of presenting before you this evening. You will perceive that they are both of the Dolichocephalus, or long-headed type, and that the individual to whom one of them belonged most probably suffered a violent death, from the fact that the cranium has been pierced entirely through by some missile, most probably an arrow; if so, the arrow-head used must have been very small, perhaps one of those small implements which I have often seen, but previously supposed were made for playthings to amuse the aboriginal children, but it would seem from this, that a grim, earnest purpose prompted their manufacture and use. The other crania were not so well preserved, and their outline could not be distinctly defined, but the frontal bone of one of them, and some fragments of the maxillary bones, would indicate very clearly that they belong to the same type as those found on the west side. I am not satisfied as to whether fire had been used in this chamber, but am inclined to think that it had been, on the east side.

Mound number two contained, also, a chamber constructed of stone, eight and a half by eight and a half feet, internal linear surface, and three and a half feet in vertical height, with a doorway in the centre of the south wall two and a half feet wide. This chamber contained large quantities of burnt human and animal bones, burnt clay, wood ashes and charcoal, extending from the plane of the base of the wall to within eighteen inches of the upper surface. Many fragments of human crania were found, but none sufficiently intact to preserve their outline, but, from their appearance, no doubt were of the same type as those found in mound number one. In the southeast corner of the chamber, at a depth of eighteen inches, the cranium which I next present you, was found. From its situation in the mound, and from its better preservation, and the fact that it differs so widely in type from the other crania, no doubt it was an intrusive burial, and belongs to our modern aborigines.

Mound number three exhibits no appearance of a stone chamber, so far as examined, and perhaps contains none, but may have contained a chamber of sun dried clay, every vestige of the walls of which has been destroyed by the great lapse of time since its erection. This mound, too, contained burnt human and animal bones, burnt clay, wood ashes and charcoal, so circumscribed in limit, and intermingled at the plane of the base of the mound, as to render it probable that the deposit accumulated on the floor of a chamber. It presents, too, other remarkable features in its contents. In addition to the human bones apparently, and which, no doubt, are, though in a fragmentary condition, of the same type as those found in numbers one and two, other bones are found which, if they prove to be human on further examination, as they most probably will, are certainly the most remarkable yet found, of which we have an account, throughout the entire world. Some of the bones found in this mound, which evidently are human, are so very diminutive as to preclude the idea that they can belong to the same race to which the other bones belong, or to any race of men now inhabiting the known regions of our globe. Of this type were found several fragments of crania, fragments of one lower and two upper maxillary bones, belonging evidently to adult individuals. Some animal bones were found in this mound, in respect to which I withhold any expression of opinion at present. They may prove to be those of the reindeer. These very remarkable waifs of a by-gone age I also have the pleasure of presenting for your examination.

Mound number four, like number three, has no appearance of containing a stone chamber, nor have I observed any burnt clay, wood ashes, or evidence of fire having been used in it, as far as opened. Only human bones were found in this mound, which are of the same general type as those found in numbers one and two, but some of them are more strongly marked, and are all in a fragmentary condition. I present you for examination from this mound, two frontal bones, one upper and two lower maxillary bones, and one femur. The specimens, you will perceive, indicate a low order of intelligence and very great muscular development. Drs. Halley and Fee, from measurements made by the former, of the femur, think the individual to whom it belonged must have been as much as seven feet five inches in stature. A creature of this commanding height, supported by such vast muscular development, with a low and rapidly retreating forehead, and a very prominent supra-orbital development, over-arching, wild, restless eyes, the wild, restless, fierce expression of which was heightened by constant watching for lurking foes, must have formed an object fearful to look upon—a savage which the wildest dream of the imagination can scarcely picture.

Mound number five contained a stone chamber eight and a half by eight and a half feet internal linear surface, and four feet in vertical height, with a doorway in the centre of the south wall two and a half feet wide. Like number two, it contained a large quantity of burnt human and animal bones, burnt clay, wood ashes and charred wood, all intermingled and extending entirely over the floor, at irregular depths. In the centre of the chamber this mingled ash-heap was not less than eight inches in thickness. Beneath it, and almost, and perhaps in places, entirely in contact with it, buried in the clay, and resting on the natural surface at the plane of the base of the wall, parts of four skeletons were found, but none of them sufficiently preserved to give their outline. Three frontal and the fragments of two maxillary bones were sufficiently intact, however, to indicate very clearly that they belong to the same race of those in number one.

The mounds opened all rest upon the undisturbed natural surface. This was singularly illustrated in mound number five, in which the root of a tree growing on it had penetrated the mound, vertically, until reaching the natural surface at the base, where, rejecting the natural formation and selecting the more nutritious, disturbed earth, grew away at right angles across the base of the mound, resting horizontally on the natural surface, affording a very suggestive hint to agriculturists. The entire absence of implements in any one of the mounds opened, unless I may except four flint flakes found in number four, which, most probably, were thrown in by accident when the mound was erected, is a matter of surprise to me, and one in which I must confess great disappointment; but other mounds, when opened, may yield different results.

I stated in my September paper, that the last level of the lake in which the loess deposit took place extended some way up Line Creek. I am strengthened in this opinion by the terrace markings which I find along the bluffs on the north side of the river. I find additional evidence, too, to confirm the opinion which I then expressed, that the spear-head found at the junction of Missouri and Troost Avenues, in this city, was deposited where found while the loess deposit was yet going on. We must not infer from the absence of implements in the mounds that none were used by the race that erected them, for within a distance varying from one-half mile to a mile from them, large quantities of flint arrow and spear-heads, stone axes, knives, flint cores and chippings, flat stones used for grinding corn, fragments of pottery, etc., are found. Some of the implements, you will perceive, are very rude, while others present a superior finish. They are found imbedded in the upper surface of the loess, along old roads, and in fields that have been in cultivation for a number of years, where the superincumbent vegetable mould has been entirely removed by attrition, or other causes. A farmer residing in the neighborhood remarked to me that the older the field the more implements were revealed by the plow; that they were not encountered by the plow in fields that had not been in cultivation ten to twenty years. The surface in Clay and Platte counties bordering on the river, where these implements are found, is very undulating, and subject to rapid change by attrition, especially in cultivated fields and along public highways. Mr. Krouse, who resides in the neighborhood, on the southern slope of the bluff overlooking the Missouri, showed me a beautiful spear-head found embedded in the loess, three feet beneath the surface. Its situation in the loess cannot be mistaken, for it was found while excavations were being made for the purpose of terracing and grading his yard. At the same level numerous flint flakes were found. These implements, evidently, were deposited before a vegetable mould was formed in the localities of their deposition, and, probably, upon what was then a lake shore.

These views are sustained by my own observations, as well as by the unanimous verdict of the people of the neighborhood, as to the situations in which the implements are found. The Line Creek pottery, you will perceive, differs from that found on the south side of the Missouri, which I had the honor to describe in my September paper, and no doubt can claim a superior antiquity. The difference is obvious, and relates to the fashioning of the vessel. While the latter shows no signs of a mould having been used in the construction of the vessel, the former has clearly delineated on the outer surface the markings of the mould in which the vessel was fashioned. Independent of this marked distinction, the pottery as yet encountered on the south side of the river is found in situations indicating a more recent deposit than that found on the north side, and most probably belonged to a different race, or, if to the same race, certainly at a later period of time.

There seems to have been two eras in this country in the manufacture of pottery,—that in which a mould, constructed of grass, the inner bark of a tree, or coarse threads made of the sinews of animals or other material, was used, inside of which the vessel was moulded and given shape, and an era in which the vessel was shaped without an outer mould. The latter, though the eras may lap in sequence of time, is subsequent to the former, and extends down to our own time, for we find pottery of this latter type now manufactured and used by some of the aboriginal races of New Mexico and Arizona.

It is highly probable when the surface of the earth in the immediate proximity of the mounds shall be disturbed by an advancing civilization that implements, now hidden by the superincumbent vegetable mold, will be found in their immediate vicinity.

As to the age of the mounds themselves, independent of the evident antiquity of the implements found in their neighborhood, they bear internal evidence of very great age, as well from the type of the mysterious race found resting in them, as from the evidence afforded by their internal structure. Careful observation failed to disclose in or beneath any one of them the least trace of local vegetable mould, while overlying them, on their external surface, the vegetable mould has attained as great thickness as is found in the surrounding country. The trees on the mounds are of the same species as those in the forest environing them, and have attained as great size and age. If there had been a vegetable mould removed at the base of the mounds before their erection, there should be some evidence remaining of its presence, either in or immediately around them; but no such evidence exists. If we consider the fact that the implements in the neighborhood are found imbedded in the loess, and the farther fact that the mounds rest upon and are entirely composed of this formation, with the exception of the accumulation at the surface, which has taken place certainly subsequently to their erection, we can scarcely escape the conclusion that they must have been built during the time the loess deposit was yet going on, or very soon after its completion, and before a perceptible vegetable mould had been formed. Prof. Aughy, in his Geological Report of Nebraska, estimates the time required for the deposit of 200 feet in thickness of loess at 20,000 years. This is perhaps a liberal estimate. The greatest thickness of the loess here does not exceed 100 feet, and the greatest thickness on the highest points, such as those upon which the mounds are erected, does not exceed 20 feet. Supposing 10,000 years for the deposit of 100 feet, 2,000 years would be required for the deposit of 20 feet; so that there would intervene 8,000 years between the last of the upper and the last of the lower deposit. After the recession of the lake waters, 8,000 years, no doubt, would give ample time for the production of a luxuriant vegetable growth, and the accumulation of a very perceptible thickness of vegetable mould.

Now, if it be true that the mounds were erected before the accummulation of a perceptible quantity of mould, it renders the high probability almost into a certainty that they were constructed before the completion of the loess deposit, and while a lake of considerable magnitude still laved a shore line extending north along the Line Creek valley and along the bluffs immediately under the mounds, that our mound builders were dwellers on the shore of a lake, which, like themselves, long since has passed away, leaving evident traces, enwrapped in mystery, of a past existence.

The great antiquity to which this necessarily leads us is not inconsistent with the immunity of the bones from decay, when we consider their evident protection from moisture, and the vicissitudes of the seasons, in the situation in which they are found, and when we consider their present chemical condition. The claim to their great antiquity is further strengthened by the fact that out of three humeri found, two of them contained perforations at the inferior extremity, and from the evident great preponderance of the muscular over the intellectual development.

The question as to the purpose for which the mounds were erected is one of difficult solution. Whether the stone chambers described are merely an improvement on chambers of similar construction made of sun-dried bricks, built in the mounds destitute of stone chambers, every vestige of which has been effaced by the great lapse of time since their construction, is a problem yet to be solved, but this is rendered highly probable by the facts presented in Mound No. 3. Supposing all the mounds to have contained chambers differing only in the material used, the question still remains to be answered—were they covered, and, if so, how were they covered? That there was not a covering of wood is evident from the fact that no appearance of decayed wood is found in the mounds, except the decayed roots of trees which have grown upon them since their construction. Nor could the covering have been of stone, or vestiges of it would be found in the mounds. If covered at all, and it is highly probable that they were, the covering must have been of the brick clay of which they are composed, and which is well adapted to the purpose, made into a stiff mortar and arched over the chamber like a bake oven, with an opening for the escape of smoke at the top; or else made of the skins of animals, enveloping the top in the shape of a tent. Are we justified in considering the chambers dwelling places as well as places of interment? Many reasons seem to justify such a conclusion. The doorway in all the chambers opening to the south, the great thickness of the ash heaps on the floor of the chambers, the intermingling of bones with the ashes, and the size of the chambers themselves, which are so unnecessarily large for mere places of sepulture—are all significant facts. The depth of the mingled ash heaps in mounds two and five precludes the idea that they could have been accumulated by any ordinary funereal rites, even though protracted for weeks. The ashes in mound number three precludes the idea, in like manner, that they could have been accumulated without a chamber having been constructed in it. That there was not a succession of interments and funereal rites is manifest from the fact that the strata overlying the ash heaps had not been disturbed, there being no evidence whatever of successive openings, except for the intrusive burial mentioned in mound number two. The invariable existence of the doorway, the number of skeletons found, and the thickness of the bed of ashes, preclude the idea of a single interment, and the undisturbed upper strata precludes the idea of successive interments made at different periods of time.

The first idea of a distinctive home for shelter and protection from the aggression of enemies, probably was suggested to man in the infancy of the race by the natural caverns so often encountered on the earth's surface. To render this more probable, we find on this continent, as well as on the continents of the East, nearly all of the accessible natural caverns containing human and animal remains intermingled in relations indicating permanent occupancy. As time advanced, the natural caverns became insufficient to supply the wants of the increasing human race, and necessity suggested the erection of shelter in imitation of the architecture suggested by nature, and if we find semi-civilized, and even civilized, nations pursuing the same style of architecture for ages together, we need not wonder at primitive man pursuing the same rude style for many successive ages. The race associated with the mounds must have been much more numerous than we find resting in them, and but comparatively few could have been interred. It is probable, from the situations in which the remains are found, covered with clay at no greater depth than the plane of the floor of the chamber, that successive interments, after the soft parts of the body had decayed, were made while the chamber was occupied as a dwelling, and so near the surface of the floor that the bones were sometimes reached by the domestic fire, as I saw illustrated in mound number five. If it is objected that this intimate relation between the living and the dead is strained and unnatural, we must remember that those for whom such relation is claimed did not scruple at feasting upon their fellow man and scattering his bones around the domestic hearth; for the animal bones and the human bones found intermingled with the ashes and other debris of the floor of the chamber were perhaps only the remains of the ordinary family repast.

The absence of any implements in the mounds would indicate that our mound builders had no religious ideas, or if they had a religious belief, that they neglected to provide for their friends on their long journey to the spirit land, and for their future abode in that aboriginal Elysium. It is not probable that captives and slaves would be sacrificed to accompany the departed spirit without also providing him implements for use in the chase, in his far away spirit home. But in rejecting this poetic idea, we must adopt one which, though less pleasing, is more practicable, and though it may be revolting to our cultivated sensibilities, form the reluctant conclusion that our mound builders were a race of cannibals. But

> "Ye, whose hearts are fresh and simple,
> Who have faith in God and nature,
> Who believe that in all ages
> Every human heart is human,
> That in every savage bosom
> There are longings, yearnings, strivings
> For the good they comprehend not,"

may spread the veil of charity over the rude past.

PHYSIOLOGY AND THERAPEUTICS.

THE FUNCTIONS OF THE UVULA AND THE PROMINENCE FORMED BY THE AZYGOS UVULÆ MUSCLES.

By Thos. F. Rumbold, M. D., St. Louis, Mo.

In the spring of 1870 I had a patient whose right nostril was of sufficient caliber to admit my little finger in its whole length. The idea occurred to me at once, that this case presented an excellent opportunity for examining the action of the uvula; and as our authorities say of this grape-shaped appendage, that "its use is not clear,"* I determined to take advantage of this opportunity to inspect its motions during mastication, deglutition and vocalization.

I had the patient keep this nostril wide open with a Kramer bi-valve ear speculum. Through this large nasal passage, thus dilated, I passed a reflector, reaching to the posterior wall of the pharyngo-nasal cavity (Fig. 1, R); on the mirror (R) I directed a calcium light, illumining the parts

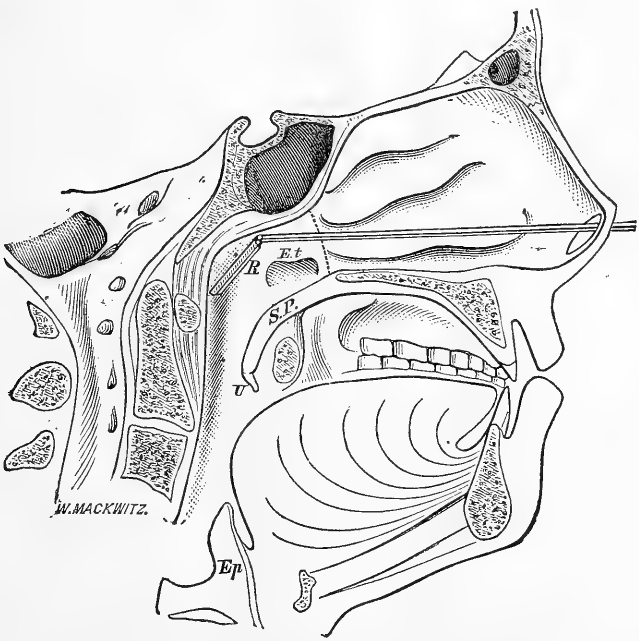

FIG. 1. Antero-posterior section of the head; R. reflector; S. P. soft Palate; U. uvula: E. t. mouth of Eustachian tube; Ep. epiglottis.

* Dunglison's Medical Dictionary.

under observation, so that the image was reflected back to my eye very distinctly. In this way I was enabled to inspect the upper or posterior surface of the soft palate, and the prominence or ridge on it that the azygos uvulæ forms (Fig. 2, Az-Pr.), the base of the tongue (T), the epiglottis (Ep), and the contents of the larynx, at the time of the attempted phonation of the sound "æ" with the mouth closed.

My observations on this patient were continued for a period of five weeks. Subsequently, I made numerous observations of a similar character on six other patients, each of whom had lost the septum nasi, but had perfect soft palates.

From notes that were taken at the time of these inspections—about seventy-five in number—I will state what part, in my judgment, the soft palate, the uvula and the azygos prominence (Fig. 2, Az-Pr, and Fig. 3) take in the acts of mastication and deglutition, and what were their positions at the time of the phonation of such simple sounds, as show enough of their action to demonstrate their apparent function; reserving for the near future, the details concerning the position of these three organs as well as that of the base of the tongue and the epiglottis during the phonation of specified sounds.

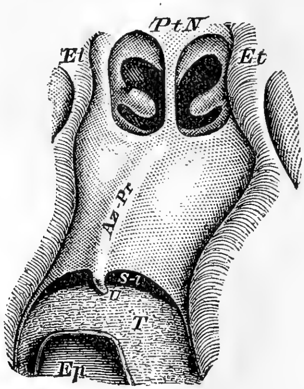

FIG. 2. View of the posterior nasal passages, the posterior surface of the soft palate and base of the tongue; Pt N. posterior nares; E. t. Eustachian tubes; Az-Pr. azygos prominence, on the upper surface of the soft palate formed by the azygos uvulæ muscles; S-l. Semi-lunar openings formed by the tongue, uvula and soft palate; T. base of tongue; Ep. epiglottis; U. uvula.

Although I know now that the uvula and azygos prominence (Figs. 2 and 3) are not required to aid the acts of mastication and deglutition, yet I will give the results of the inspections while these processes were going on, because these results contain points of interest when taken in connection with phonation.

During mastication the whole free border of the soft palate rested on the base of the tongue, reaching within a short distance of the epiglottis. In five of the cases, the uvula was not in sight at any time, and seemed to be doubled under the velum, so as to lie between it and the tongue (Fig. 4).

Two patients had elongated uvulas, which, sometimes, hung down on the base of the tongue, and frequently touched the epiglottis. The uvula was always contracted; the evidence of this condition was the increased height

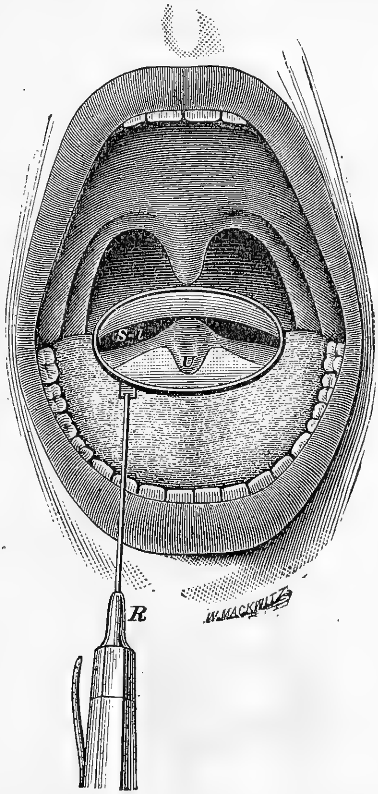

FIG. 3. The image, seen on the hinged reflector (R), of the lower edge of the soft palate and the lower or posterior concave surface of the uvula (U), showing, also, the higher semi-lunar shaped openings (S-1) made by the azygos prominence touching the posterior wall of the pharynx.

of the azygos prominence, formed by the contracted azygos uvulæ (Fig. 2, Az-Pr).

During the act of deglutition, the soft palate was pushed backward by the alimentary bolus until the posterior wall of the pharynx was reached; the motion was continued in an upward direction until the upper surface of the velum was high enough to cover and close both Eustachian tubes (Fig. 1, S. P. E. t.), pushing the reflector (R) upward and forward; then the velum descended, as the alimentary bolus was swallowed, until its lower border touched the base of the tongue.

When I began to make observations, my attention was directed to the uvula alone; but the varying height of the azygos prominences during vocalization (Fig. 2, Az-Pr.) in this, my first patient, drew my attention to it, and what I discovered with respect to it, was confirmed in the subsequent examination of the other cases, namely: that this prominence, whose existence I had known for some time, though I had never thought of assign-

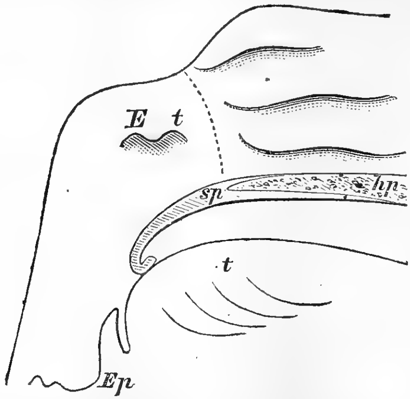

FIG. 4. Antero-posterior section of the hard palate (hp.) and the soft palate (sp.), showing the position of the uvula resting on the base of the tongue (t.); Ep. epiglottis; E. t. mouth of Eustachian tube.

ing to it any function or use, was of as much importance in vocalization as, if not more than the uvula itself; so that, while seeking for the function of this grape-shaped appendage, I discovered a new organ, and ascertained its function at the same time.

During the vocalization of sounds that passed through the nose alone, the whole free border of the soft palate rested on the base of the tongue (Fig. 4), the uvula was not in sight at any time. During the vocalization of sounds that passed through the mouth alone, the soft palate was raised, and about 4‴ of its lower border was pressed against the posterior wall of the pharynx (Fig. 5).

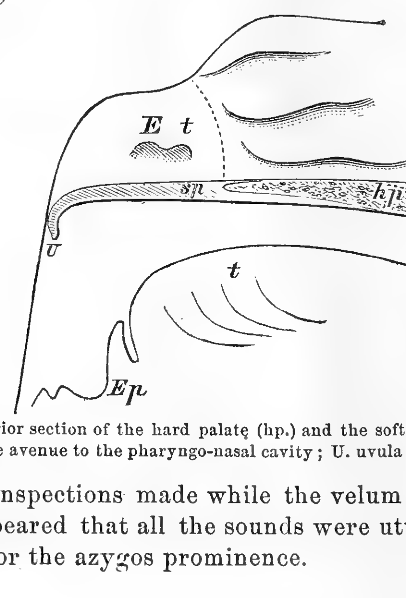

FIG. 5. Antero-posterior section of the hard palate (hp.) and the soft palate (sp.) showing the position of the velum closing the avenue to the pharyngo-nasal cavity; U. uvula; t. tongue; Ep. epiglottis.

From repeated inspections made while the velum was in each of these two positions, it appeared that all the sounds were uttered without the aid of either the uvula or the azygos prominence.

The favorable opportunity for observing what assistance is rendered by the azygos prominence and the uvula, is during the phonation of such sounds as are required to pass through the mouth and nose at the same time. While these sounds were uttered, the soft palate was either suspended, so that but a small part of its central portion and the uvula rested on the base of the tongue (Fig. 6), or it was raised to such a height that the azygos prominence touched the posterior wall of the pharynx (Fig. 3). In each situation that the velum occupied, the communication between the fauces and the mouth, and between the fauces and the pharyngo-nasal cavity, was divided into two equal, or nearly equal, semi-lunar openings. In the first position named, the division was made by the uvula and a small part of the central portion of the velum resting on the base of the tongue (Fig. 6, S-l), and in the second position, the partition was made by the azygos prominence (Fig. 3, S-l), touching the posterior wall of the pharynx.

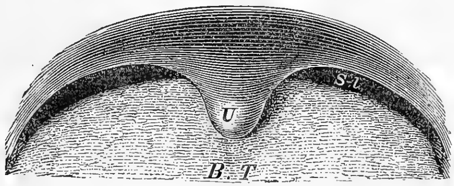

FIG. 6. View of the anterior surface of the soft palate, the uvula and the base of the tongue, showing the lower semi-lunar-shaped openings (S-l·) formed by the uvula (U.) and a part of the central portion of the velum resting on the base of the tongue (B. T.).

In one patient I noticed, on several occasions, that the uvula seemed to be resting on the base of the tongue, while, at the same time, the azygos prominence was touching the posterior wall of the pharynx.

The formation of the inferior or posterior surface of the uvula (Fig. 3, U), as well as the peculiar position in which it hangs from the velum (Figs. 1 and 2, U), indicates that this surface lies on the base of the tongue frequently, its extremity being directed forward (Fig. 4). It is evident that this position is the best one in which it could be placed, to prevent the free edge of the soft palate from being shaken by the force of the air from the lungs.

It was observed repeatedly, that the free border of the velum was not at any time suspended in the current of air during vocalization, but was always situated in such positions that it received support, which prevented it from being thrown into vibrations by the force of the air that came from the larynx. To show how the support was given, I will mention again all of the principal positions that this vocal valve was observed to assume. (*a.*) It was either elevated and pressed against the posterior wall of the pharynx (Fig. 5, U), during the phonation of sounds that passed through the mouth alone; or, (*b.*) removed from this wall a small distance, but not so far as to prevent the azygos prominence from touching it (Fig. 3, seen in the image on the reflector R.), for sounds that passed mostly through the mouth and a little through the pharyngo-nasal cavity; or, (*c.*) lowered to allow the uvula and a small part of the central portion of the velum to rest on the base of the tongue (Fig. 6), for sounds that passed mostly through the nose and a little through the mouth; or, (*d.*) still lower, so that its whole free border rested on the base of the tongue (Fig. 4), for the formation of sounds that passed the nose alone. In a few instances, as have been mentioned, I have seen the second and third positions combined, *i. e.*, the uvula resting on the base of the tongue, and the azygos prominence touching the posterior wall of the pharynx at the same time (Figs. 6 and 3).

From the effects of these positions of the velum on phonation, it would appear that one of its functions is to act as a valve, by directing the voice from the larynx into the mouth alone for the formation of one kind of tone; into the nose alone for another; and to divide the sound so as to allow it to escape from both of these openings, for still others. It is evident that while the velum is resting wholly on the base of the tongue, or is pressed against the posterior wall of the pharynx, the liability for its free border to vibrate by the force of the air is reduced to a minimum; but when this valve is in either position that requires it to divide the sound between the mouth and the nose, then, on account of its free edge being suspended and placed immediately in the current of air from the larynx, the liability for it to vibrate is increased to a maximum.

A provision is necessary to prevent these vibrations. This provision, I am led to believe from my observations, is found in the uvula and the azygos prominence formed by the azygos uvulæ muscles. It is located in the centre of this very mobile palate or valve, and by its support in both of the positions that require suspension (Figs. 3 and 4), prevents it from being shaken by the force of the current of air from the lungs. There can be no doubt, that if there were no uvula and azygos prominenee to prevent this thin edge of suspended flesh from vibrating, it would be shaken to such a degree as to impart a tremulousness to the tone of all sounds forcibly uttered that pass through the mouth and nose at the same time.

The following questions have been asked frequently:

"1st. If the uvula is required to prevent the free border of the velum from vibrating during phonation, will not its loss impair the voice?"

"2d. How do you account for the improvement of the voice in many instances, after its removal?"

The excision of the uvula can effect those sounds only which are formed by its assistance, and not even then, if they are pronounced with the usual strength of voice, because the contact of the central portion of the velum on the base of the tongue will be support enough to prevent the velum from being shaken; therefore, the difficulty in pronouncing, in high and loud tones, those sounds that are required to pass mostly through the nose and a little through the mouth, will be in proportion to the amount of loss of support that the velum suffers; as usual excisions leave a stump of the uvula and the central portion of the soft palate, these will prevent any vibrations during speech made with the *usual* force of the lungs.

I have observed that a patient, who has just undergone an operation for excision of an elongated and hypertrophied uvula, may talk immediately in an *ordinary* tone with greater ease than before the operation, but, just as soon as he utters words with *more* than the *usual* force of voice, such, for instance, as he would require to address a person across the street, some of the efforts will remind him of the excised uvula, and though not causing as much pain as the knife did, will cause so much that he will be compelled to cut his sentence short of its intended length. The reason of this effect on the uvula appears to me to be this: the heavy uvula had given so much support to the soft palate that, although it had been acting as an impediment to all kinds of sounds, the velum required very little of its own pressure on the base of the tongue (Fig. 6) to prevent it from being thrown into motion by the air from the larynx, but when the superabundant portion of the uvula was removed, the velum required greater pressure upon the base of the tongue to prevent these vibrations, and this pressure was the occasion of the pain. Of course the loss of the whole of the uvula does not interfere with the formation of the two semi-lunar-shaped openings by the free border of the velum and the dorsum of the tongue (Fig. 6), by which the voice is allowed to escape from the mouth, and thus provide for perfect vocalization; it takes away a *part only* of the support from the soft palate. Even if there be no stump left by the excision, the tongue will learn to overcome the defect by the increased elevation of its dorsum, which may be made more convex than was required to form the two semi-lunar openings when the whole of the uvula was present, and in this way allow both a greater pressure and more of the central portion of the velum to rest on the tongue. But if the soft palate suffer so much of a loss of substance in its central portion, that its concavity is equal to the convexity of the dorsum of the tongue, thereby preventing the formation of the semi-lunar-shaped openings, and neutralizing all support, there will be some sounds, such as pass mostly through the pharyngo-nasal cavity and a little through the mouth, given imperfectly in spite of all efforts to overcome it, because the proper tone requires that the velum should be raised to allow a part of the sound to pass to the mouth, and this act of elevation exposes it to the force of the air from the larynx, which force is the cause of the imperfection of the sounds, by causing the unsupported edge to vibrate. Again, if the loss in the centre of the velum be greater than can be closed by the greatest convexity of the dorsum of the tongue, the disability will be equal to that caused by a perforation of the soft palate, and in addition, there will be a tremulousness to many semi-nasal tones, on loud speaking, as addressing an individual at a distance. That the intermittent tone is occasioned by the vibrations of the central portion of the velum, is evidenced by the pain in this part after lengthy speaking in a loud voice. This pain was experienced by two patients while under my care, whose soft palates were notched to this extent by ulceration.

In answer to the second question—"How to account for the improvement of the voice after the removal of the uvula?"—I would ask, if it is claimed that this improvement in speech is equal to the patient's vocalization at the time that his uvula was in a healthy condition. I am sure, because the observations made on this subject during the last five years have taught me to be so, that the answer to this question should be given in the negative. That a relative improvement in speech does follow an excision of an elongated or hypertrophied uvula there can be no doubt, because this operation brings the organ nearer to its normal size and condition; but it resembles the improvement made by perforating the membrana tympani in a case of deafness caused by a closure of the Eustachian tube; such improvement can never equal the normal function of the organ. This being the case, the effect of the excision will be to remove the cause of a mechanical hindrance to every word uttered by the patient, made in any degree of force, and it will leave a stump which will not be a cause of hindrance, but a cause of an inability to pronounce some words on forced vocalization only, and this even will be overcome in time by the dorsum of the tongue becoming more convex. Therefore, to admit that the removal of a uvula thus diseased may improve the ability to speak in the usual tone of voice, does not prove that it was the uvula's removal that was the origin of the improvement, for, if such were the case, the excision of the healthy uvula would not only be advisable, but desirable.

The effect of the amputation of the whole of the uvula, besides its being a loss of the greater part of the support to the velum, prevents the formation of the azygos prominence to its greatest height, which is done by the contraction or elevation of the azygos uvulæ muscles, which terminate in uvula. This height of the prominence is required to prevent, by its contact with the posterior wall of the pharynx, the vibrations of the velum during the formation of many semi-nasal sounds.

The nearer that the surgeon can make the diseased uvula take the shape and size of the normal one, the nearer will it approach its normal function, that is, rendering the soft palate a non-vibratory valve, which is required for perfect phonation.—*St. Louis Medical and Surgical Journal.*

JUVENILE NEAR-SIGHTEDNESS.

The following extract from a report made by Dr. James A. Spaulding to the Maine Medical Association, while applying chiefly to the children of the Portland schools, will be found of decided interest to all teachers and parents, as well as to school boards having the construction of public school buildings in charge. The number of near-sighted young people is alarmingly on the increase here as well as elsewhere, and the subject of prevention deserves and demands earnest attention and prompt action where it is found necessary:

"For some time past I have been occupied in making an examination of the sight of the children in the various primary and grammar schools of the city. It had also been my intention to examine the scholars in the high schools, but, owing to some mistakes and misunderstandings, nothing was done in these schools. The method of examination was as follows: Each scholar was tested singly with Sneller's test type at twenty feet distance, in a bright room. Those whose sight was in any way affected were in this way sifted out from those with good sight. After this had been carefully done, in some cases by the teachers, to whose accuracy and care I owe my thanks, and in some by myself, I tested each scholar with defective sight with the series of larger test type, found the exact proportional amount of sight, and then corrected it by convex or concave glasses, as the case might demand. Where no improvement could be obtained by either concave or convex glasses, astigmatic glasses were tried. Some of the scholars with defective vision, which could not be corrected by glasses, were examined with the ophthalmoscope. In regard to the latter point, I regret that I was unable to make more extended search. In all, 2,372 children were thus tested.

"The results may be thus briefly stated: In the grammar schools I found twenty per cent. of the children with defective sight, and in the primary schools eight and a half per cent. Of these twenty per cent. in the grammar schools, I found sixteen per cent. in all who were at all short-sighted, while ten per cent. of the whole required glasses stronger than thirty-six inches focus to correct the myopia present. Of the eight and a half per cent. in the primary schools, I found seven per cent. who were short-sighted, and of the whole, three and a half per cent. who required glasses stronger than thirty-six inches focus. To repeat, there was ten per cent. myopic, requiring a glass stronger than thirty-six inches focus for correction in the grammar schools, in children from ten to fifteen years of age; and three and a half in the primary schools, in children from five to ten years of age. Myopia was more common, in the proportion of five to four, among girls than boys, especially in the higher degrees. In quite a number of cases of high degrees of myopia, it was impossible by any kind of glasses to bring about perfect sight, thus showing that short-sight in high degrees is attended with a defect of visual power, and is not a blessing, as some people will persist in insisting upon.

"The first point on which I would speak is lighting the school rooms. How, then, are they off for light? In reply it may be said that some of them are remarkably well lighted, and noticeably those of the North School, where the light comes in brightest from one side, and from the other side and rear in subdued amount. Some are moderately well lighted, as those in the High School building, with equal light from both sides; but where the windows are not cut up high enough toward the ceiling, they do not let in light enough on a gloomy day to make the middle rows of seats desirable for any scholars at all, even those with the sharpest eyesight; while some, and especially the Park Street Grammar School, are miserably lighted. In this school the light strikes directly in the faces of the scholars, and also directly upon their backs. Thus they have a glare in front and a shadow thrown from behind. In this school, and in a school similarly lighted on Brackett street, I found the greatest percentage of defective sight. It always seems to me just as absurd to read with the face directed toward the brightest source of light, thus placing the eyes in the most disadvantageous position possible, as it would be to weigh down one's self with fetters when going walking.

"It is useless to suggest that the teachers of a crowded school might find time to watch the scholars with defective sight, to see that they do not hold their books too close to their eyes, or to make them hold their books up from the desk and parallel to their faces, or to prevent too long and unremitting search for unimportant places in an atlas. But what the teachers can do and ought to do is this: Every scholar known to have defective sight ought to have a seat in the very best light in the room, irrespective of what class each may belong to. I would range the defective-sighted scholars along each outer row of desks as near to the windows as possible, where the light comes from the sides; while in those schools which are so unfortunate as to have the light from the front and back both, I would put them on the rows of seats nearest the back windows.

"In every school there should be a rest every half hour, if even for a minute only, from reading, and especially from writing and drawing, the pursuit of which, for a steady hour, is wearisome enough to a practiced eye, and much more so to all young beginners, who strain, as it were, at each point in a line, so as to make it as nearly like the copy as possible. Fine handwriting ought never to have been invented, and especially in the ruled-off way—the measured space way—in which it is taught nowadays. Any child taught a large, round, flowing hand will soon learn enough to make it proportionately smaller, as space and paper demand.

"In examining a few of the scholars who wore glasses, I was struck with the general and unnecessary strength of their glasses. Too strong glasses require too much exertion of the eye. Glasses for short-sighted persons should be the weakest possible with which they can see clearly at a distance, while for reading they should, except in some rare cases, be still weaker.

"Shall we give glasses for reading in short-sight? For children whose sight can be perfectly corrected by concave glasses, that is, if there be no amblyopia as a result of myopic distension of the eye-ball, with changes in the inner tunics of the eye, and if the eye has good power of accommodating itself for near objects, I see no objection to their wearing glasses; and with this advantage, that, if worn early in life, they will, in all probability, prevent a further increase in the myopia. After twenty years of age, and with advancing age, they may be diminished in strength, or even convex glasses may be worn.

"But, after all, the only place to teach children how to use their eyes well—how not to abuse them—ought to be at home. They should be taught that the light should always come from the side, or even over the shoulder; that the book should be kept up, if possible, and never in the lap; that they should always have a shade over a lamp standing on a table at a level with their eyes, and especially if they have to face the light, as in writing; and that all bending positions, and reading in the twilight, or with the sunlight pouring over the book, are very harmful to the eyes.

"In some of the school children I found myopia hereditary, being traceable to parents and even grand-parents, and the points just mentioned about the use and abuse of the eyes can not be too strongly urged upon the parents and taught by them to their children, when they know that they themselves have defective vision, and that it is often hereditary, descending to their children in increased degree unless carefully watched.

"It is useless to create a panic about short-sight, or to say that, with advancing education, we are growing a race of short-sighted persons. It is wrong to accuse the schools as the sole cause of all cases of short-sight. That would be carrying a few facts, a few statistics, to an unwarranted extreme. Hereditary influence I believe to be a great effect in causing short-sight, while bad light at night, at home, poor light in the school-rooms, want of care in selecting well-printed books, urging girls too much to learn fine sewing and embroidery, too long-continued and unrested work at school, too strong glasses given by opticians, and many bodily ails and weaknesses, such as scarlatina and measles, are other factors always busy in producing and continuing short-sight, all of which may, with care and thoughtfulness, be to some extent obviated, and naturally at no better time than during the years at school."

THE VALUE OF CONDIMENTS.

By condiments we mean substances like sugar, spices, vinegar and others that are employed to impart flavor and piquancy to the staple foods. They are usually regarded as non-essential, and some writers on dietetics have gone so far as to condemn their use, unless in rare instances and in the most infinitesimal proportions. Like all good things they are liable to be abused, but when properly used they are valuable elements in our daily food. Professor Voigt, of Munich, than whom there is no higher authority on such a subject, considers that their importance has not been sufficiently recognized. It is not enough that food should contain alimentary principles in proper quantity; to render it really nutritious there must also be a supply of condiments. These have been compared to oil in a machine, which neither makes good the waste of material nor supplies motive power, yet causes it to work better; they render essential service in the processes of nutrition, though they are not of themselves able to prevent the waste of any part of the body. "A dietary deprived of condiments, a mere mixture of alimentary principles without taste or smell, is unendurable, and causes nausea and vomiting." It is not until condiments are added to aliment that it really becomes food. Extreme hunger may enable us to dispense with them, as it may compel us to devour what at other times would be disgusting, but under ordinary circumstances they are an essential part of our diet.

Condiments have an important influence upon the process of digestion and nutrition. The mere sight or thought of a savory dish "makes the mouth water"—that is, it makes the salivary glands pour out their secretion copiously, which is an important stage in digestion, especially for certain articles of food. Experiments made upon dogs show that a similar effect is produced upon the gastric secretion, and thus the work of digestion is further promoted. The loss of the sense of taste would be not merely a loss of enjoyment, but a positive injury to the digestive system. The very smell of food may do us good, just as certain odors will restore a person who has fainted.

It does not follow, because condiments are useful, that we may not have too much of them; on the contrary, their best effect depends upon their being used in moderation. The more decided the flavor of any article of food, the sooner does it pall upon the appetite. It is one of the peculiar merits of French cookery that flavors are so delicately blended; no one is specially prominent, and yet by their different combinations a wonderful variety of appetizing effects is produced. We Yankees, like the English, are apt to use condiments in a coarse, reckless way, and thus miss their finer and more exquisite effects, besides losing much of the benefit that might be derived from them. By a nicer care in their employment, the plainest and simplest diet might be made at once more delicious and more digestible.—*Journal of Chemistry.*

Diphtheria.—It has lately been discovered by a Boston physician that hyposulphite of soda, which is extensively used in photography, is a specific remedy against diphtheria. The discoverer, Dr. Chenery, reports a large number of cases (158 in his own practice) saved by the use of this remedy. The dose is from 5 to 15 grains or more in syrup, every two or four hours, according to age and circumstances. A large dose will do no harm, except that it will cause the patient to purge. The solution or mixture can be used in doses of five drops to half a drachm in milk, which is perhaps the best way of administering it to young children.

Dr. David Price of Leveritt, Mass., writes that there is little danger when the disease is taken in hand by the physician at the outset, with the following treatment: Chlorate of potassa, 2 drachms; hot water, 6 ounces; alcohol, 4 drachms; Creosote, 8 drops; muratic acid, 30 drops. This is to be used as a gargle every thirty minutes. Internally, he prescribes the following remedy: Chlorate of potassa, 3 drachms; water, 6 ounces; sugar, 1 ounce; tincture of muriate of iron, 2 drachms. Dose, a teaspoonfull every four hours. He says that with this treatment not one case in twenty will die, but the disease will give way in a few hours, and convalescence will be rapid.

Any effective method of treating that terrible scourge of childhood, scarlet fever, is of universal interest. A correspondent of the London *Lancet* writes that he has obtained remarkable success in treating the disease by anointing the patient twice daily with sulphur ointment, and administering five to ten grains of sulphur in a little jam three times a day. Besides this the room was filled twice a day with sulphur fumes. He states that under this treatment "each case improved immediately, and none were over eight days in making a complete recovery."

If small-pox can be cured with cream of tartar, it is time everybody knew the fact. A correspondent of the Liverpool *Mercury* says that it is not only a never-failing remedy in the worst cases, but it is also a preventive. The directions are to dissolve one ounce of cream of tartar in a pint of boiling water, and to drink, when cold, at short intervals. Not a very exact prescription, to be sure; but the remedy is so simple that it may be well worth trying. It is said that thousands have thus been cured, and that no marks of the disease remain.

In regard to the use of fruits so that they shall promote, instead of impairing health, a London journal says: "When fruit does harm, it is because it is eaten at improper times, in improper quantities, or before it is ripened and is fit for the human stomach. A distinguished physician has said that if his patients would make a practice of eating a couple of good oranges before breakfast, from February to June, his practice would be gone. The principal evil is that we do not eat enough fruit; that we injure its finer qualities with sugar; that we drown them with cream. We need the medicinal action of the pure fruit acids in our system, and their cooling, corrective influence."

ENGINEERING.

CONTINUOUS RAILWAY BRAKES.

We find in *Engineering*, of January 5th, a series of diagrams and tables illustrating the competitive trials of the Westinghouse Automatic, and Smith's Vacuum Brakes, upon the North British Railway, under the direction of Mr. Drummond, general manager.

While it is impossible to reproduce the diagrams here, we will give some of the more important results, as shown by the tables, premising that the prominent essentials of an efficient continuous railway brake are promptness of action, the power to bring a train to a state of rest in the shortest time, and the ability to be self-acting in case of separation of a train, and that in these trials "the trains were about of equal weight, the engines exactly alike, the brake blocks applied to the wheels in the same manner, the percentage of weights not retarded by the direct application of the brake blocks nearly the same in each case, and the trains run on the same day, under uniform conditions of weather, while the results were taken in precisely the same way on each train, in a way which met with the acquiescence and approval of the representatives of both systems alike."

TEST NUMBER 1.

Smith's Vacuum Brake:	
Boiler pressure on applying ejector	138 pounds
" " on shutting off ejector	138 "
Vacuum	17 inches
Westinghouse Automatic Brake:	
Pressure in air reservoir	85 pounds

TEST NUMBER 2.

Smith's Vacuum Brake:	
Boiler pressure on applying ejector	144 pounds
" " on shutting off ejector	144 "
Vacuum	18 inches
Westinghouse Automatic Brake:	
Pressure in air reservoir	90 pounds

TEST NUMBER 3.

Smith's Vacuum Brake:	
Boiler pressure on applying ejector	140 pounds
" " on shutting off ejector	137 "
Vacuum	17 inches
Westinghouse Automatic Brake:	
Pressure in air reservoir	90 pounds

TEST NUMBER 4.

Smith's Vacuum Brake:	
Boiler pressure on applying ejector	144 pounds
" " on shutting off ejector	142 "
Vacuum	18 inches
Westinghouse Automatic Brake:	
Pressure in air reservoir	97½ pounds

TEST NUMBER 5.

Smith's Vacuum Brake:

Boiler pressure on applying ejector....................108 pounds
" " on shutting off ejector....................108 "
Vacuum.................... 20 inches

Westinghouse Automatic Brake:

Pressure in air reservoir .... 90 pounds

REFERENCE NUMBERS.	TEST NO. 1.		TEST NO. 2.		TEST NO. 3.		TEST NO. 4.		TEST NO. 5.	
	S. V.	W. A.	S. V.	W. A.	S. V.	W. A.	S. V.	W. A	S. V.	W. A.
Speed of trains in miles per hour at application of brakes..........	29.5	30	40	40	49.5	49.75	54	54	55	55
Number of seconds occupied in making stop..........................	17.25	13	23	16	27	19	28	21	28	21
No. feet run in making stop........	480	328	860	550	1250	798	1310	952	1375	910
Foot tons of energy in train, including influence of wheels at application of brake $Wr^2 \div 2g$...	5036	4995	9256	8880	14.159	13.736	16.840	16.184	17.450	16 789
Retarding power of brakes in lbs. per ton, deduced from distance run after applying brakes (including influence of wheels).....	146 31	221 9	150.85	235.8	158.24	250.3	179.63	24.72	177.54	269.5
Retarding power of brakes in lbs. per ton, deduced from time occupied in making stop (including influence of wheels)..........	184.47	256.6	193 41	277.5	203.5	290.6	214.07	28.50	218.03	290.08
Speed of train (miles per hour) after brakes had been applied over 100 feet..........................	29.5	28.25	39.75	39.75	49.5	49.5	53.75	53.25	54.75	53.75
Speed of train (miles per hour) after brakes had been applied over 200 feet..........................	27.5	22	39.5	37	49.25	47.5	53.25	52	54	52
Speed of train (miles per hour) after brakes had been applied over 300 feet..........................	23.25	13	38.25	33	48.75	43.5	52.25	48.25	53	48
Speed of train (miles per hour) after brakes had been applied over 400 feet..........................	17.5	Stop'd	36.25	25.75	48	40	51.25	44.75	52	43
Speed of train (miles per hour) after brakes had been applied over 500 feet..........................	Stop'd	"	32.05	16.5	46.75	35	48.5	40.5	50	39
Speed of train (miles per hour) after brakes had been applied over 900 feet..........................	"	"	Stop'd	Stop'd	35	Stop'd	36.25	15	38.25	7

We quote that portion of the article bearing more particularly upon the trials made by the North British Railway Company:

"We publish this week a very complete table in which are arranged all the important deductions from these trials, as well as a second sheet containing exact reproductions of the diagrams taken, and some miscellaneous data. These diagrams and the table taken together are so clear as to require little comment. We propose, however, to point out some of the most interesting features in them. It will be observed that, for convenience of comparison, the stops made by the Vacuum and Automatic trains are arranged in pairs, the initial speeds in each pair corresponding, if not exactly, at least so nearly as to preserve the comparison accurate. In the same way the lines recording both Vacuum and Automatic stops for the corresponding speeds are arranged upon one diagram, the index figures attached to which are repeated in the Table. These figures show the number of the stops made on the day of the trial, and all of which we have not thought it necessary to reproduce.

Diagrams Nos. 2, S. V. and 3 W. A. (Test No. 1), refer to the performances of the Vacuum and Automatic brakes respectively, and the lowest speed at which stops were made. An analysis of this diagram and its results applies equally in its degree to the higher speed stops, as it will be observed that the relative efficiencies of the Vacuum brake to the Automatic vary but little independent of speed. The time occupied is here nearly half as long again, as is also the distance run. The total foot-tons of energy in the Vacuum train are rather greater than in the Westinghouse, although the speed of the latter is somewhat higher. The efficiency of the Westinghouse brake, as compared with the Vacuum, is, however, much higher, even when both are in full work, while the latter is not in operation in reducing the speed until some considerable distance has been run after the moment of application. Thus, in the diagrams we are just now considering, it will be observed that the speed of the Vacuum train was unaffected at a distance of 100 ft. after application of brakes, and when the Westinghouse had already done more than 5 per cent. of its work by reducing the train speed from 30 to 28.5 miles per hour. This distance is much more marked at the end of the third 100 ft., when the speeds stand 23.15 and 13 respectively, and the train energies at 3216 and 938 tons, so that the values of the two brakes at this point as regards speeds are in the proportion of 1.77 to 1, and as regards train energy destroyed 3.4 to 1. In other words, when the Automatic brake had performed its work, the Vacuum train was still traveling at a relatively high rate of speed. This result is, of course, more striking, in the higher velocity stops. Thus in one of the three trials at 40 miles per hour, the speeds at 500 ft. from application of brake (Test No. 2) are 32.5 and 16.5 respectively, or almost exactly 2 to 1, while the foot-tons of energy are in the ratio of 4 to 1. In other experiments this is far more strongly marked, as in the trials 12 S. V. and 12 W. A. (Test No. 4), where the speeds were in each case 54 miles an hour. In these, at the end of 900 ft., the speeds are 38.25 and 7 respectively, or $5\frac{1}{2}$ to 1, while the foot-tons of energy were 8400 against 270. The Vacuum train was thus proceeding at a rate of over 38 miles an hour, or faster than the train which was wrecked at Arlsey Siding the other day, after the Automatic train was at rest. Of course, it is in these stops at the highest speeds that the qualities of the two brakes manifest themselves; they have more work to do, and as they require a longer time in which to do it, they afford better opportunities for analysis. Thus taking runs 11 S. V. and W. A. (Test No. 5), at 55 miles an hour, we find that the time required for the former is one-third greater than for the latter, and the distance run 50 per cent. greater. In these particular tests an interesting point occurs, which manifests itself on the diagram. The Westinghouse brake was not applied until a brief interval after the diagram was commenced. The consequence was that while the Vacuum train was lessened in speed 45 per cent., the Westinghouse train remained almost at its normal velocity. But during the second 100 ft. the Westinghouse performed 7.27 per cent. of its work against 1.82 per cent. of the Vacuum train, and it is only until 400 ft. are passed that the Vacuum brake approaches its full performance, which, however, is not reached till after the Automatic brake has arrested the train. In fact, the whole of these trials clearly show the disadvantages inherent to the Vacuum system, which we have consistently pointed out—an unavoidable slowness in action at the moment when the promptest application possible is required. The somewhat interesting comparison that these trials render practicable between the detailed performances of the two systems, and a theoretically perfect stop, we shall have to defer till another occasion, remarking only meantime that while the Westinghouse Automatic shows an average percentage of absolute efficiency of about 65, the Vacuum falls to 30, while taking the absolute thoretical distance that must be run in making a stop, the ratios are about as 70 to 50.

"The tables and diagrams which record the whole results of the trials call for little further remark. It should be borne in mind that the foot-tons of energy given do not represent the total *vis viva* of the train, which must be always a certain amount in excess of the energies tabulated. These amounts—due to the influence of the revolving wheels—are interminable, but must always fall short of the total energies stored up in the wheels, so that they represent at a maximum only a small addition to the total foot-tons.

"Speaking generally of the experiments, it should be remarked that they were conducted by the gentlemen who had undertaken the work on behalf of Mr. Drummond, with the utmost care, so that perfect reliance may be placed in the results obtained, excepting so far as certain small irregularities were occasionally developed in the diagrams that declare themselves on inspection of the table, and do not affect the general results.

"In our article on page 279 of our seventeenth volume, we observed that 'the Westinghouse brake, admirable though its performance was, is capable of far better things as regards promptness in stopping the train. * * * There can be no doubt that the increased value of the retarding force per second, as compared with the resistance per yard, indicates a want of promptness either in the handling or in the action of the brakes.' These remarks referred to the brake as originally introduced upon English railways by Mr. Westinghouse, and the critcisms we then passed have been found to be fully justified by the great improvement he has since made, and which developed into the Automatic brake, that made its first appearance here at the Newark trials. The work performed by it on the North British Railway the other day, was generally better than that done on the former occasion, and it would now seem that the system is susceptible of but little further improvement. The same remark also applies to the Vacuum brake, although, as already stated, the performances on the North British Railway are not a true indication of its actual capabilities, having been increased by the aid of auxiliary means not used in practice. Still both systems are now before the public in almost their best form; what they are capable of absolutely and relatively doing is now clearly known, and there can no longer be any excuse for hesitation in adopting one or the other of them, on the alleged want of knowledge as to which is the more efficient of the two. The necessity for some means of controlling trains is proved weekly by accidents of more or less severity upon one or other of our railways, and we fail to see upon what grounds, those with whom the power of adoption rests, fail to make use of means ready to their hands, or why in making a selection they prefer one system that falls 50 per cent. below the degree of efficiency of another."

STEAM TROLLY.

Mr. Joseph Green Cooke, the locomotive and car superintendent of the Oude and Rohilkunde Railway, has constructed a steam trolly or carriage, the object of which is to enable resident engineers to inspect their tracks, bridges and works with rapidity without being obliged to travel by train. Its weight being less than 1200 pounds, three men can remove it from the track in fifty seconds, and for that purpose it is constructed in three parts, viz: 1st, its fuel and water boxes; 2d, the boiler, frame, engine and one pair of wheels, and 3d, the front wheels.

The trolly has one steam cylinder only, this being $3\frac{1}{8}$ inches in diameter, and 6 inch stroke, and the connecting rod being coupled direct to the one end of the driving axle. The boiler is constructed on the Field system and has 12 square feet of heating surface, composed of 36 Field tubes. The working pressure is 100 lbs. to the square inch. The diameter of the wheels is two feet, and the speed from 10 to 20 miles an hour, according to the weather. The boiler when empty weighs 156 lbs. and will hold 3½ gallons of water. The fuel box and tank together weigh 50 lbs. when empty, and will carry 50 lbs. of coal and 6 gallons of water. The engine exclusive of crank and axle weighs 45 lbs. Seven persons can ride upon it at the same time.

Apparatus for Burning Crude Petroleum in Locomotives.—Thomas Urquhart, Superintendent of the Griazitzaritzen Railway of Russia, has designed an apparatus for burning crude petroleum or naphtha waste in locomotives, which is described with illustrations in *Engineering*. The petroleum for this purpose is brought from Baku on the Caspian Sea, being transported by water up the Volga to Izaritzin, the terminus of the railway, and it was expected that it would take the place of wood in the Russian railways. While it has been comparatively successful from an engineering point of view, there are some objections, among which are the great amount of smoke made when the locomotive is standing, and the fact that several severe gas explosions have taken place on the firing door being opened. In addition to these objections it has been demonstrated that the use of petroleum is more expensive than that of wood.

METEOROLOGY.

THE METEOR OF DECEMBER 21, 1876.

On the evening of Dec. 21st, 1876, a very large and remarkable meteor, apparently originating in Kansas, passed over the central belt of the United States, in an easterly direction, and disappeared in Pennsylvania. It was first observed, as far as has been learned, at Hays City, Kansas, passing slowly along at an altitude of about 25 degrees above the horizon, with a downward tendency, so much so that most observers all along its course believed that it reached the earth within a mile or two from them. Reports from Hays City, Lawrence and Fort Scott, Kansas; Kansas City, Jefferson City and St. Louis, Missouri; Keokuk and Burlington, Iowa; Dorchester, Quincy, Jacksonville, Nameoki, Champaign, Galesburg, Lewiston and Chicago, Illinois; Lafayette, Garrett, Indianapolis and Fort Wayne, Indiana; Louisville, Kentucky, Cincinnati, Dayton, Columbus and Cleveland, Ohio, and the northwestern portion of Pennsylvania, show that its course was a little north of east, and that the time occupied in traveling this great distance of not less than 1,000 miles, was between 8:15 and 9:15 P. M., a velocity equal to nearly 100 miles per minute, after allowing for the earth's motion. Its height was estimated by various scientific observers at something like 160 miles, at its first appearance, and probably about 20 miles at the moment of its disappearance.

At the time of its passage over this city, it seemed to those who saw it about as large as the full moon, with a train from 25 to 100 feet long, of a reddish or orange color and entirely unattended with any noise or sound. As it passed further east it seems to have become broken up in several parts, to have assumed brighter colors, to have thrown off a large amount of luminous scintillation, and to have been accompanied, in some instances, with a rushing or hissing sound and in others with explosions of greater or less violence. At St. Louis the descriptions given by various observers are reported as follows in the *Globe-Democrat:*

"A very remarkable meteor startled the people of this neighborhood last night. Shortly after 8 o'clock a sudden flash of light illuminated the western heavens, and in a few seconds a train of light was observed running along through the misty atmosphere from south to north and northeast. While a *Globe-Democrat* reporter was walking westward on Elm street, between Sixth and Seventh, the illumination of the sky made itself apparent. The atmosphere was exceedingly hazy, and hence probably resulted some of the effect. On the south of the western end of that part of Elm street is situated the high building known as Pope's College, and it was from the southwestern angle of this building that the first flash of the meteoric visitor was perceived. At this time the reporter was standing about half way down towards the eastern end of the block, but the sudden illumination made him run westward towards Seventh street. Arrived at a spot about fifty feet from the western end of the block, the portentous trail of the meteor became apparent, and thence it ran at about an elevation of twenty-two degrees from the horizon, northwardly with a slight deflection to the east, and tending towards the earth till it disappeared behind the high buildings on Market street. Judging from its general course, the probabilities seemed that the meteorolite fell somewhere in Northern Illinois. Meteors, of the ordinary run, are too common at this time of year to require more than a passing comment. But the one in question was evidently playing a star engagement. Its appearance from the standpoint mentioned was somewhat similar to an express train running through a fog, with headlight streaming out its light to the front, and the disjected train of sparks in its trail seeming like an exaggerated representation of the lights from the car windows. Moreover, to keep up the similitude to the train of cars, the speed with which the phenomenon passed over the field of vision was nothing greater than an ordinary train of steam cars. A peculiar effect was visible when the meteor passed just below the moon, when the fierce flame of its light was somewhat dimmed. But from this point northwards it gathered in intensity, and when it reached a point due west from the point of observation, the color of its flames, which heretofore had been a sickly yellow, broke out into a coruscation of violet, crimson and purple, and a low hissing noise, like that resulting from the combustion of nitre, fell on the ear.

"Along the streets in the neighborhood where the reporter stood and ran, the people rushed out and stared in open-mouthed wonder at the portentous visitor, and men ran hither and thither in dread wonder—while women were to be seen lifting up their hands as though in dread of some horrible visitation. The entire passage of the meteor across the horizon occupied about twenty to thirty seconds, and its slow movement enabled a close scrutiny of its changing course and varying colors. Other accounts of the appearance of the phenomenon are appended.

"A gentleman passing on High street, near Clark avenue, at about 8:30 o'clock last evening, was startled by a bright flash reflected from the buildings on the east side of the street, and, on suddenly turning to look about, beheld a meteor of most remarkable brilliancy, which was, at that time, in two parts, at about fifteen degrees above the horizon, curving upwards slightly and moving in a course from the southwest to the northeast. The parts were about equal in size, and reminding one, for the instant, of two very large skyrockets, one traveling directly and closely in the path of the other, leaving a luminous belt behind—not broad, but very bright. As the course curved again toward the north, the two simultaneously separated into innumerable parts, each of which expanded wonderfully into bodies of as great brilliancy as the principal ones; and all traveled forward together, but differing considerably in speed.

Mr. A. S. Aloe, optician, No. 206 North Fourth street, describes the meteor as the most wonderful aerial phenomenon he ever beheld. His point of observation was Fourth street, between Pine and Olive. The time was about 8:30. It appeared in the western horizon, and moved in an eastern direction over the city. It was extremely brilliant, and startled all who were fortunate enough to obtain a view of it. The atmosphere was hazy, and the stars were dimly visible. The strange body appeared like a large ball of fire, with a tail at least a hundred feet in length. The tail was as bright as the body, and both presented the hues of the rainbow, but glowed with a more fiery luster. It was visible about ten seconds, and a further view of it was obstructed by the buildings on the east side of the street. It was a most beautiful and startling spectacle, differing from any meteor the observer has ever seen or read of.

Another gentleman, who came into the *Globe-Democrat* office immediately after the meteor passed, said it was visible for thirty seconds; that when first seen by him it resembled a large globe of ground glass, sailing along from west to east at a moderate rate of speed. When near the zenith it divided into four parts, each part being connected with the others by links of fire, and the whole displaying colors of red, blue, green, yellow, etc. It was the most magnificently beautiful thing of the sort he had ever seen. The atmosphere was hazy, and if the fiery messenger is to be taken as an omen of anything, its appearance at such a time is favorable to Hayes.

A gentleman seated near a front window in the Four Courts had his attention attracted, at 8:25 o'clock, to the passing meteor by the sudden and brilliant lighting of the heavens. The incandescent body described an arc from the southwest to northeast, casting off in its progress a brilliant shower of sparks, which were gathered in a luminous train of the most dazzing colors, the whole constituting an exhibition of pyrotechnics beggaring the descriptive powers. Seemingly the time occupied in passing from horizon to horizon was more than a minute, though under such extraordinary circumstances, the incentive for watching the movements on the face of the heavens was greater than for following the movements on the face of a timekeeper, had there been opportunity for doing the latter. The fiery mass disappeared as it came, cutting its luminous way through the atmosphere, so startling a visitor that few had comprehended its character until it had passed from sight.

TELEGRAPHIC ACCOUNTS.

JACKSONVILLE, ILL., Dec. 21.—A grand and singularly beautiful meteoric display was witnessed from this city to-night, about 8:30 o'clock. The meteor first came in view away to the west, and about 30° above the horizon. it passed seemingly but a short distance north of the city, and was finally lost to sight away to the eastward. When first seen it seemed a blazing, burning ball, nearly as large as a full moon, and appeared to be moving directly towards this city. As it swept along, with its fiery tail, some twenty degrees in length, and some ten to twenty blazing fragments, it presented a spectacle of surpassing magnificence and beauty. When this great ball of fire reached a point considerably east of north, it burst into some ten or twelve fragments, not unlike in appearance to the bursting of a rocket, and these fragments seemed to finally disappear in a bank of clouds which hung near the eastern horizon. The meteor was of such surpassing brilliancy that the whole earth and heavens were lighted up so brightly that persons could be distinguished at a distance in the streets almost as plainly as in daylight. The light was such that it gave a subdued green coloring to the earth, trees, buildings and every other object. From the time the meteor was first seen in the west till lost sight of in the east full twenty seconds must have passed. A singular feature of the phenomenon was that, instead of passing in its flight earthward, its path from west to east seemed in an exactly horizontal direction. Nothing of the kind of such grandeur, brilliancy and beauty was ever before witnessed here.

NAMEOKI, ILL., Dec. 21.—This evening, at 8:35 p. m., by Chicago time, we beheld a rare phenomenon, in the shape of a three-balled meteor, linked together by a stream or chain of fire, presenting the appearance of a luminous substance of various colors that lighted the heavens with its grandeur. It came from the south west, and traveled on a level with the horizon directly toward the north-east, at a moderate speed, leaving innumerable sparks in its path, and increasing in length as it disappeared.

CHAMPAIGN, ILL., Dec. 21.—A meteor of wonderful brilliancy passed over this place to-night about 9 o'clock, exploding in the north part of the city. Its explosion raised the alarm of fire among a large audience assembled in the basement of the Congregational Church, and temporarily interrupted the speaking. It came from the west, and appeared about the size of an ordinary wash-tub, with a trail nearly 400 feet long, and continually dropped fire.

LAWRENCE, KS., Dec. 21.—A large and brilliant meteor passed from west to east over this city this evening, about 8:15 o'clock, remaining in sight nearly one minute.

LAFAYETTE, IND., December 21.—A very large and brilliant meteor passed over the city about 8:30 o'clock this evening. When first discovered it was a little north of west, and passed out of sight in a northeasterly direction. Persons who saw it describe it as one of the most beautiful ever witnessed. The main body appeared nearly as large as the moon when full, and seemed to be followed by a large number of smaller bodies, like stars, very brilliant and of all colors. It was accompanied by a loud noise—some describe it as a very heavy explosion, followed by a noise as of a heavy train of cars in rapid motion, and by others as of heavy continuous thunder, accompanied by a visible jarring of the ground. It was noticed by parties on the cars coming in from Indianapolis and on the train from Toledo. It is reported as having been seen at Attica, Delphi, Rockfield, Logansport and Earl Park.

Garrett, Ind., December 21.—The people of this place are considerably perplexed because of a very remarkable phenomenon which occurred this evening about 9 o'clock. There was an explosion in the air almost as loud as a cannon, and much sharper. The heavens became illuminated, and many persons became alarmed and rushed into the streets. There was a rumbling sound after the explosion, which lasted over five minutes.

Jacksonville, Ill., December 22.—The grand and gorgeous meteoric display Thursday night was the topic of interest here to-day. All who had the good fortune to witness the sight concur in the opinion that it was a scene of resplendent beauty and sublimity. An interesting fact, in addition to those telegraphed by your correspondent, is that the passage of the blazing meteor athwart the heavens from southwest to northeast was followed, first by a hissing sound, caused, doubtless, by the cleaving of the air, and then a rumbling sound like distant thunder, supposed to have been caused by a rushing together of the air to fill the vacuum.

Keokuk, Iowa, December 22.—The meteor which passed over this city last night was the most brilliant ever witnessed here. Its apparent path was downward about forty degrees eastward, and it left behind a train of light embracing all the tints of the solar spectrum blended into an illuminating blue and purple. This train continued visible for more than a minute, assuming a serpentine form in places while drifting into obscurity. The height of the meteor when it passed here is estimated at twenty miles. Soon after the flash a perceptible concussion was felt. At Laharpe, Ill., a distance of about forty miles from here, the detonation resembled the report of a cannon, and it is thought that the final explosion occurred not far from that place. The meteor threw off a large number of fragmentary lights.

Burlington, Iowa, December 22.—A large number of citizens on the street at 9 o'clock this evening witnessed the descent of an immense flaming aerolite, which passed over the city in a direction east of northeast, and probably went into the earth somewhere in Illinois. Its extraordinary size and evident proximity to the earth were remarked, and its light was so brilliant that many aver that newspapers could have been read by it. The train that followed it was many-hued, as though composed of cooling particles of metal. It was seen also at Unionville, Missouri, and at Fort Madison, Iowa.

Dorchester, Ill., December 22.—The most wonderful display of a meteoric nature was seen at 8:45 last night. It appeared to rise in the west, and was at its highest elevation about three-fifths of the distance from the northern horizon to the zenith. It appeared as wide as the disc of the sun. The trail was about thirty degrees in length, emitting in appearance sparks and balls of fire. Time in view, about thirty seconds; disappearing about fifteen degrees above the horizon in the northeast.

Quincy, Ill., December 22.—The brilliant meteor of last night has been the general theme of conversation here to-day.

Louisville, Ky., December 22.—A telegram from Bloomington, Indiana, to the Associated Press agent at Louisville, says Prof. Wylie, of the Indiana University, distinctly saw, for three minutes, the meteor of last evening.

Prof. William Black, of Keokuk, Iowa, remarks: "The brilliant meteoric display of last evening was quite a remarkable event in the history of the science in which the phenomenon is embraced. Ordinary shooting stars are of frequent occurrence. No audible sound proceeds from them, because they are bodies of feeble density, and are generally dissipated or consumed while yet at an altitude of fifty miles above the earth's surface. But the spectacle of a dazzling detonating meteor, as the one of last evening, is quite rare.

"Coming from a cosmical cloud in stellar space, the fire ball appeared in the heavens over Northern Missouri and Southern Iowa at an altitude of about twenty-five degrees above the horizon. The light must have attracted the attention of multitudes of persons as far north as Dubuque, Iowa, and as far south as Memphis, Tenn. From such data as could be obtained, its apparent path was downward about forty degrees eastward, and, owing to the existence of fibrous cirrus clouds in the upper atmosphere, it left behind a train of light embracing all the tints of the solar spectrum, blended into a beautiful blue and purple. From a comparison of numerous reports and statements, it is computed that the height of this meteor at the first instant of apparition, was 160 miles and at the instant of its disappearance probably twenty miles, the length of its visible path being more than 130 miles, which distance was described by the nucleus in about ten seconds, although the train of light which followed continued visible for more than a minute, assuming a serpentine form in places while drifting into obscurity. Soon after the flash quite a perceptible concussion must have been felt about 200 miles in every direction, centering in the vicinity of La Harpe, Ill., at which place the detonation resembled the report of a cannon.

"Before the final explosion, however, quite a large number of fragmentary lights were detached from the main nucleus, by process of the enormous heat. The column of smoke resulting from the combustion must have been a thousand feet in diameter.

"The exact height of the fire-ball at the time of the final explosion and disappearance cannot be accurately determined, but it is evident from the accelerated density of the lower atmosphere, that it was not within twenty miles of the earth's surface. Of 800 detonating meteors found recorded in scientific journals, some attended by almost deafening reports, and much more brilliant than the one last evening, none have descended within twenty miles of the surface of the earth before final combustion. It is not unfrequent, however, after the main explosion, for fragments to reach the earth as aerolites."

As Seen at Chicago.—The meteor which flashed across the country from the southwest to the north east, on Thursday evening, passed south of Chicago; along its southern horizon, in fact. Persons on the streets, at about 9 o'clock, however, noticed the reflection of its light. This diffused light flashed overhead like that from rapid lightning flashes below the horizon on a summer's night. These flashes followed each other in quick succession, and were reflected on the snow for, perhaps, three to five seconds. The light was perfectly white, not so bright or palpable as that reflected from a distant thunder storm, and shimmered like the aurora borealis, which it resembled more than anything else, except that it had no radiating points, no outlines, but was diffused over the entire sky. Before any one had time to get over the surprise and turn to see whence it came, it was gone. It was not known then that a meteor had crossed the heavens, and there were various speculations by the few who saw it as to the cause. One thought that, by some means, all the street lamps had flashed up suddenly, as gas has been observed to do in houses, and that the light was thus reflected from the clouds. Another attributed it to the aurora borealis, and another to some unusual electric condition of the atmosphere, and supported his belief with the statement that a rumbling sound, as of thunder, and a trembling of the earth accompanied it. The writer, who was on Park avenue, near Robey street, at the time, and was brought to a halt by it, did not actually hear any noise, nor feel any trembling of the earth, though he had an impression as to both—as though the ghosts of those two phenomena were present. It may have been that this impression arose from the fact that these results generally follow the seeing of a flash of lightning. It was natural at the moment to attribute the flash to lightning, whereupon nerve and ear were at once put in readiness to feel the tremble and hear the thunder in confirmation of the evidence given by the eye.

A correspondent of the *Times*, down in Indiana, speaking of the phenomenon, nicely avoids the point of libel by stating that "an alleged earthquake" passed over that section.

GALESBURG, ILL., December 22.—This community was startled, between 8 and 9 o'clock last night, by a large and brilliant meteor passing in a northeasterly direction over the city. Prof. Comstock, of Knox College, gives the following description of it in this evening's *Republican-Register*: My family were startled by a brilliant flash of light which fell upon the carpet in the presence of lamp-light as being green. The children gave the alarm and rushed to the south door, just in time to see the explosion of a splendid meteor. They say it was red, blue, and all colors, like a rocket. The light cast upon the clouds had a greenish tint. I was too late to see anything, though it could not have been more than ten seconds from the time the alarm was given until I was in the open air. However, in about five minutes (estimated, not observed), a tremendous explosion occurred, consisting of two reports, with an interval of about a half-second. Every window in the house seemed to rattle, and the solid earth to tremble. It closely resembled a heavy clap of thunder. If the time between the flash and the report was five minutes, the distance must have been something over sixty miles, and the angle of elevation, as near as can be estimated from the testimony of the observers, would give a height of less than forty miles.

LEWISTON, ILL., December 22.—On Thursday evening at 8:45, a magnificent meteor, apparently as large as a flour barrel, passed nearly directly over this place, from west to a little northeast. It left behind it a luminous trail of fire over 40 degrees in length, and occupied about a full minute in passing across the heavens. The passage of the meteor was followed by a loud report that shook the earth and greatly alarmed the people. Houses trembled violently, and many persons ran outdoors in tremor. After the first report a heavy rumbling sound seemed to pass over from the east to the southwest, and could be heard for five minutes. The meteor lighted up the streets as bright as day. The wonderful phenomenon almost caused a terrible disaster in Beadle's Opera Hall, where a large audience were witnessing a play by a local company. The flash of the meteor lighted up the hall with a sudden glare, and the cry of "fire" was raised. Instantly the audience were in a panic, and hundreds made frantic efforts to get through the doorway. Only the prompt action of a few cool men prevented a rush down the stairway that must have resulted in many women and children being crushed. Order was soon restored, and no one sustained serious injuries.

CHICAGO TRIBUNE EDITORIAL.—The unusually brilliant meteor which passed over the States of Kansas, Missouri, Illinois, Indiana, Ohio and Pennsylvania appears to have followed a path that was very much curved with respect to a plane perpendicular to the earth's surface. Unfortunately, none of the numerous notices of the stranger that have come to hand give its position with sufficient accuracy to permit a calculation to be made of its course. In order, however, to believe that all of them should be approximately correct, it is necessary to assume that the path was several scores of miles above the surface of the earth, and nearly parallel thereto, during the flight over Illinois. This view is supported by the testimony of an observer at Valparaiso, Ind., who heard the noise in from three to four minutes after the flash. Taking 4.6 seconds per mile as the rate at which sound travels through the atmosphere, this would give the distance of the meteor from Valparaiso as forty to fifty miles. It appears to have been subject to numerous minor explosions in its visible flight and as its surface became more rapidly heated than the interior by friction in passing through our atmosphere. The Indiana observations indicate that it was almost entirely dissipated into fragments before it ceased to be visible. The last portions probably fell to the earth in New York State; but none of them may be large enough to constitute what we call a "good find." It appears probable that the meteor was less largely composed of iron than is the case with meteorites that are found in large masses, as an earthy consistence is most favorable to such disintegration as is testified to by the majority of observers of the meteor under notice.

INDIANAPOLIS ACCOUNT.—A remarkable meteor was observed in Kansas, Missouri, Indiana, Illinois and Ohio on the 21st inst., which gave forth a brilliant light and exploded with a loud noise, like the sound of a cannon or a heavy clap of thunder. As seen at Indianapolis, it was followed by a train of smaller meteors, estimated at nearly one hundred. Its color changed from yellow to green and crimson. A low, hissing noise was heard when it was directly overhead, and a rumble like a train of cars followed its passage.

According to the best authorities meteors are small planetary bodies, partly disseminated, partly grouped in annular zones, which revolve in elliptical orbits round the sun. When these small planetary bodies come within the sphere of the earth's attraction they obey its influence, and, darting down, give rise to the phenomena of shooting stars and meteoric stones. As these bodies, while obeying the earth's attraction, traverse our atmosphere with planetary velocity they would, no doubt, cause a terrible bombardment, and from their vast numbers render our planet absolutely uninhabitable if their very speed had not been made the means of neutralizing their otherwise disastrous effects: for, raised to incandescence by the atmospheric friction engendered by their enormous velocity of from eighteen to thirty-six miles per second, by far the greater portion of the aerolites are dissipated by heat, and a small number only reaches the surface of the earth in a solid form.

Flammarion accounts for the light displayed in the movement of bolides or solid meteors as being entirely due to the heat produced by the compression of the air, and for their explosions and the falling of aerolites to the earth, by the unequal pressure upon different portions of the body. "Attributing to the bolide a speed of four and one-half miles per second,—by no means an exagerated estimate, M. Haidinger calculates the resisting pressure which it meets with from the air at more than twenty-two atmospheres. Such a pressure evidently tends to crush the body which is exposed to it, and if this body in its more or less irregular shape and constitution offers portions of itself which are more opposed than the others to the action of this pressure, these portions may give way and become suddenly detached from the bolide."

Mr. R. P. Greg, published some years since in the *American Journal of Science* a pamphlet giving an arrangement of meteorites based on their mineralogical and structural characters, in which he divided them into three classes: aerolites, siderolites and aerosiderites; the first containing little or no iron and the latter two composed largely of that mineral. The intensely magnetic power of meteorites was demonstrated conclusively by the action of one described by Dr. Massena, of Brazil, in 1868. He says, "this aerolite so disturbed the magnetic instruments that the declinometer turned its pole from the north to the west; the horizontal magnometer turned toward the west eight divisions of the scale; the vertical magnometer fell in its center of gravity, and finally the compass oscillated fifteen degrees from east to west."

Numerous analyses have been made of meteoric stones, most of which demonstrate the existence of iron in large proportions, frequently as much as 90 per cent., but as indicated in the classification of Mr. Greg, sometimes very small quantities are present. In such meteorites the mass is found to consist principally of silica and alkalies. Meteoric stones have been found in various parts of the world, some of the largest of which were discovered in Greenland by a scientific expedition from Sweden, in 1870, the largest weighing about 25 tons and having a maximum sectional area of 42 square feet; another weighed 21 tons, others 9 and 10 tons. Another colossal aerolite was brought from Charcas, in Mexico, which weighed 15¼ cwt., and was of the shape of a truncated cone. Smaller ones weighing from a pound or two up to 300 or 400 lbs., are of very common occurrence.

THE BENGAL STORM WAVE.

The disaster which befell the slumbering people of Backergunge, Noakhally and neighboring districts of Eastern Bengal on the night of the 31st of October, 1876, was probably one of the most fearful and terrible in its results that has ever visited any portion of the earth since the Noachian deluge. Without warning, the waters of the Bay of Bengal were suddenly driven upon the land in a single overwhelming wave, from ten to thirty feet high, submerging several outlying inhabited islands, and sweeping inland some five or six miles. The official statement in the Bombay *Gazette* gives the details as follows:

"An official minute by Sir R. Temple, respecting the effects of the cyclone and storm wave, says: 'I visited the islands of Sundeep, Hattia, Shahbuzpore, and the western coast of the river district of Backergunge. In all the localities visited I took the number in each of the villages, and had the precise mortality in each house ascertained in my prescence on the spot, to prevent the possibility of deception. From authentic data thus obtained, I was able to check the local estimates and measure the actual mischief done. Messrs. Reynolds, Beverly, Dr. Weir and the local officials accompanied me. We apprehend that in an area of 3,000 square miles about 1,162,000 persons had been suddenly thrown more or less in danger, of whom 215,000 must have perished. This is only an estimate. The exact number is not known yet, and perhaps never will be. The storm-wave rose to the height of ten or twenty feet. The Noakhally people think it came from the sea up the Meghna with salt water, and then the cyclone turned it round and rolled the fresh water of the river down; the refluence caused the piling up of the fresh and salt water, which rushed over the surrounding districts; drowned bodies were carried great distances; corpses began to putrefy before the waters retired. The Mahometan population have no cremation, and the masses of corruption of human and animal bodies were frequent, presenting a sickening spectacle. Many corpses were seen at sea; the bodies of living and dead were borne across the arm of the sea from Sundeep to Chittagong, the former clinging to the roofs of their own houses. The force of the inundation appears to have lasted from midnight to two o'clock in the morning. By daybreak there was much subsidence of the flood, and by noon the survivors came down from the trees and regained terra firma. The boats, great and small, which constitute the only means of carriage in these tracts, are all lost. The Noakhally authorities were thus bereft of resources for moving across the floods, and this was a very hard case on the Hattia Islands, where the people were for three days succorless. In the Backergunge District the boats were saved, but much wealth was lost almost entirely, in the form of agricultural crops or cattle. With the exception of Dowlutkhan, a trading town, which was clean destroyed, 8,000 inhabitants, a quarter of the number, perished. On approaching it we steamed for two miles through the creek; the banks were strewn with human bodies.'"

The India correspondent of the London *Telegraph* writes that three waves in succession, varying from ten to twenty feet in height, swept over the doomed district. Many who survived the first shock were overwhelmed in the second or third wave, and drowned before they could reach a place of refuge. The women and children naturally were the most numerous victims, though some were washed into the branches of trees and thereby saved. The trees, indeed, were thickly peopled that dreadful night until daylight broke, and then it was found that not a few had escaped from drowning only to perish of cold. In one tree a man hugging a pig was seen close to a young woman clasping her babe to her bosom. The latter two were alive and unhurt, while the two former were stiffened in death. The long, sharp thorns of the madar tree saved some scores of women by catching their dresses and holding them fast till the wave had passed onward.

The correspondent of the London *Times* writes from Calcutta, November 19th as follows:

"Further details received regarding the cyclone of the 31st of October prove it to have been one of the most terrible calamities on record. Estimates based on official returns from each police section put the loss of life in the districts of Backergunge, Noakhally and Chittagong at not less than 215,000. Probably this figure, enormous as it appears, is still short of the truth. Three large islands—Dakhin Shahabuzpure, Hattia and Sundeep—and numerous small islands were entirely submerged by the storm-wave, and also the mainland for some five or six miles inland. These islands are all situated in or near the estuary of the Meghna, a river formed by the confluence of the Ganges and Brahmapootra Rivers, the largest being Dakhin, Shahabuzpore, in extent 800 square miles, with a population of about 240,000. The population of Hattia and Sundeep together is about 100,000. Up to 11 p. m., on the night of the catastrophe, there were no signs of danger, but before midnight the storm wave swept over the island to a depth in places of twenty feet, surprising the people in their beds.

Happily it is the custom in those districts to plant dense groves of trees, chiefly cocoanut and palm, round the villages. The trees afforded shelter to the villagers, and almost all the survivors saved themselves by climbing among their branches. Some took refuge on the roofs, but the water entering the houses burst off the roofs, and the receding waves carried them out to sea, with the people still clinging to them. A few were carried thus from Sundeep across the channel, ten miles broad, to Chittagong, but the vast majority were never heard of again. The country is perfectly flat, and therefore, trees were the only secure refuge. Almost every one perished who failed in reaching trees. There is scarcely a household in the islands and adjacent coast that has not lost many of its members. The cattle were all drowned. All the boats were swept away, and as wheeled carriages were unknown in those delta districts, the people were thus deprived of means of communication. Almost all the civil officers and police officials in Dakhin Shahabuzpore, except the Deputy Magistrate in charge, perished.

A strange fact about the disaster is that in Dakhin Shahabuzpore and Hattia most of the damage was done by the storm wave from the north sweeping down the Meghna. Several theories have been started to account for this. One is that the cyclone, forming in the bay, struck the shore first near Chittagong, and went north for some distance, and then turned southward again. Another is that the wind blew back the waters of the Meghna, which rebounded with terrific force when the pressure relaxed. A third supposition is that there were two parallel storms, with a center of calm between them. The first or third theory seems most probable, as in Sundeep and Chittagong the destruction came from the south.

The condition of the survivors is better than might have been expected. There was much distress for two or three days, but things are now improving. Backergunge is a great rice-producing district. Its peasantry are the most prosperous in Bengal. Their stores are mostly kept under ground, and have been, of course, thoroughly soaked; but it is believed that they are not seriously damaged. Wherever Sir R. Temple went he saw the people drying their grain in the sun. The cocoanuts will help to give subsistence till the harvest. The growing crops, which were nearly ready for reaping, and which gave splendid promise, have suffered greatly, but will still yield a fair harvest. For some days much disorder prevailed, and robberies were attempted. This state of things was soon rectified. About sixty relief centers have been established. Persons actually destitute will be relieved, but no large sums will be spent. It is believed that all danger of distress will be over after two or three weeks. The district officers are acting with great energy. Sir R. Temple started for the scene of the misfortune immediately the news was received in Calcutta, and he personally visited the suffering districts, going from village to village, and making inquiries regarding the extent of the disaster. He returned to Calcutta on Thursday.

CYCLONES OF OTHER PERIODS.

"One of the earliest cyclones of which details have been recorded occurred not in the usual season, but in December, 1789. It was accompanied by a huge storm wave, which broke on the coast at Coringa, near the mouth of the Godavery. In this case, as in several other cases on record, the coast was swept by three successive waves, the first of which drove all before it, and flooded the town with several feet of water; the second overtopped the first, and covered all the neighboring district, while the third dashed its waters over all. Nearly all the town, with 30,000 inhabitants, was destroyed, while the shipping at anchor in the bay was thrown far up on to the land. This very spot was visited by an almost equally destructive cyclone wave in 1839. On October 31st, 1831, one hundred and fifty miles of the country at the mouth of the Ganges was swept by a wave which obliterated three hundred native villages and destroyed 10,000 of the inhabitants. Other destructive hurricanes are recorded as having occurred on the same coast on October 7th, 1832, and September 21st, 1839. On October 21st, 1833, a wave swept the mouth of the Hooghly, and overwhelmed 10,000 people; while, on the 21st of the previous May, three successive waves, as at Coringa, swept away six hundred villages and destroyed 50,000 people. The last of these waves was nine feet higher than the highest tide, and the barometer is said to have suddenly fallen as much as two inches.

"In the Calcutta cyclone of October 5, 1864, the devastation was almost solely due to the effect of the cyclone wave, the extent of country laid under water having been 1,500 square miles. It was of little avail that the banks of the Hooghly and its feeders and the island at its mouth were protected by dikes and embankments of from eight to ten feet high; these, even if they had been strong enough to withstand the shock of the wave, were far overtopped by it, and the land inside laid under water to a depth of from six feet to eighteen feet. In the Hooghly the greatest height of this memorable cyclone wave recorded was sixteen and a half feet above high spring-tide level, and about twenty-seven feet above the mean level of the sea. Even as far up as Calcutta it was about the same height as the highest spring-tide, and fourteen and a half feet above mean sea level. The wave was felt as high up as Mehurpore, on the Matabangha. The loss of life directly caused by the storm wave was not less than 50,000, and would probably have been enormously greater had the wave caught the people asleep, as has been the case at Backergunge.

"In the brief space of one month after the Hooghly disaster of 1864, on November 5, a scarcely less destructive wave dashed over the coast at Masulipitam, at the mouth of the Kistnah, where the curve of the coast is precisely of a nature to intercept and concentrate the power of such a wave. The loss of life in this case was something like 35,000 people. Only three years later, November 1, 1867, the Calcutta district had another similar visitation, happily not nearly so destructive, as only 1,000 lives were lost, though 30,000 native huts were swept away.

"Of all recorded previous catastrophes of this kind, the most terrible occurred in 1862, and the natives still remember it as the *banya*, or flood of 1229 B. S. This cyclone appears to have had a very wide range, extending far inland, and to the east, and far beyond Calcutta to the west. It swept over all the islands at the mouth of the Hooghly and over the neighboring coasts. Fortunately the wave broke in the early evening, and, as the cyclone had been raging for some time, the people were in some measure prepared. Still, it is stated, 100,000 of the inhabitants and as many cattle were destroyed, and property to the extent of more than 1,000,000 rupees."

REMARKABLE AURORAL DISPLAY IN COLORADO.

The interesting meteorological occurrence of the 23d ult., consisted in the simultaneous appearance of several parhelia or mock suns, connected with one another by a white horizontal circle or halo, at the same height above the horizon as the sun. The sun was surrounded by two concentric circular coronæ, and an arc of another circle whose centre was in the zenith touched the outer circle which surrounded the sun. There were traces of other arcs of circles, but none which were very distinct. The primary or inner circle around the sun was at a distance of twenty-two degrees, consequently had a diameter of forty-four degrees. The outer circle was at a distance of forty-five degrees, or had a diameter of ninety degrees.

The circle whose centre was in the zenith had a diameter of thirty-six degrees—eight degrees less than that nearest the sun. This circle, or rather arc of a circle, as also the entire circle next the sun, were very brightly tinted with the prismatic colors; red occupying the centre of the luminous circle, indigo and violet the outer part, shading away by insensible degrees till they were blended with the general color of the sky. The color of the sky inside of the principal circle was an intense dark blue, sometimes beautifully flecked with white clouds, while the space inside the zenith circle was even of a darker blue, and at times almost black, with purplish tinge.

The most satisfactory explanation of this curious but rare phenomenon is to attribute it to the refraction and reflection of light, due to a peculiar state of the atmosphere. When the moisture of the atmosphere congeals into snow or frost, it assumes various crystalline forms. Under certain circumstances the form of these crystals is such that the faces are inclined to each other in an angle of sixty degress. A ray of light passing through a crystal of ice of this form would be refracted from a straight line at an angle of twenty-two degrees. To the eye of an observer, therefore, the halo would appear at a distance from the sun equal to twenty-two degrees. This theory is also an explanation of the order in which the colors occur. The ratio of refraction of the violet ray being greater than the red, the former would occupy the part of the halo farthest from the sun. The secondary halos and parhelia are probably the result partly of reflection and partly of double refraction.

Similar phenomena have been described by Aristotle, Pliny, Scheiner, Descartes and others, the best description being that of Hevelius, as observed by him at Dantzic on the 20th of February, 1661. Parhelia very seldom remain visible more than two hours. That of the 23d inst. was of longer duration than any heretofore recorded, being distinctly visible for over five hours.—*Boulder News.*

In connection with some electric experiments elucidatory of the phenomena of the auroras, PLANTE states that one might conclude that the aurora results from the diffusion in the upper strata of the atmosphere around the magnetic poles of the positive electricity emanating from the polar regions themselves; which emanations may take place either obscurely, when no obstacle is interposed, or may take place visibly, as auroral light, by meeting with aqueous masses either in the solid or liquid state; which matter is vaporized by the heat evolved in the electric discharge, and is subsequently again precipitated either as rain or snow at the surface of the globe.

THE CLOUD BURSTS IN NEVADA.

The San Francisco *Bulletin* says: "Nevada has again been visited with the meteorologic phenomena of cloud-bursts. Heavy rains prevailed all over Nevada, but the cloud-bursts, as two years ago, seem to have been confined to the eastern portion of the State. The recent calamity near Eureka has been the more destructive, and it is a little singular that the phenomenon should have occurred within a few minutes of the same time as that which, two years ago, on the same day of the month, caused such a large destruction of property. Meteorology is one of the least understood of all the sciences, but, from the investigations which have been made, there is reason to believe that as more knowledge is obtained it may be reduced to an exact science in the same manner as astronomy. It has, to some extent, been demonstrated that storms, as other natural phenomena, move in cycles of time and place. Scientists will, therefore, be led to the inquiry whether any reasonable conclusion can be deduced from the occurrences on Sunday night and those of two years ago at Eureka. The investigations which were made after the cloud-bursts of 1874 resulted in the theory that these interior water-spouts were caused by clouds heavily charged with rain in a dense state coming in contact with some lofty peak. The fact that they usually occurred in mountainous regions adds weight to this theory. The cloud-burst of Sunday at Eureka, was not, according to the account telegraphed, of such power and force as that occurring in 1874. But the loss of life has been greater this time, although the destruction of property is less. Two years ago the burst caused such a torrent of water to pour through the streets of Eureka as to wash away dwellings and stores. The loss of life is now appalling. Thirteen Chinamen, wood-choppers, and a camp of Italians, at work lumbering, are reported to have been washed away. There was a cloud-burst on Sunday further east than Eureka. This occured nine miles east of Elko. Such a torrent of water rushed down a mountain side that a large landslide was the result, which was precipitated upon a freight train, ditching it. Another also occurred last night on the line of the Central Pacific, between Mill City and Humboldt, in Humboldt county, Nevada, which laid the track of the road under water for several miles. It is more than probable that we shall hear of additional ones in other portions of Nevada, as we did in 1874. One inconvenience to the people of California from these disturbances of nature is that the telegraph wires get out of order, if the poles are not washed away, and communication with the East is temporarily suspended.

An Immense Aerolite.—The large number of meteors lately observed in the sky has attracted considerable attention, especially among scientific men, who are of the opinion that the earth is passing through a belt of aerolites. There is some diversity of opinion regarding the nature and origin of these stones, of which it is calculated at least 5,000 fall upon the earth's surface yearly. The theory most widely accepted is that they are bodies of our planetary system that have come near enough to be acted upon by the earth's gravitation, and thus drawn out of their orbits. A great many aerolites have been found, and nearly every scientific institution in the world is possessed of one or more. The largest of which there is any authentic record was found by a Swedish arctic expedition in 1870, on the west coast of Greenland. It weighs twenty-five tons, and is now at the Royal Academy at Stockholm.

An aerolite of probably much greater size was seen last Friday night by a reporter who was belated on the Ocean House road. At about 12:45, he noticed a peculiar light on the sand and sea around him, and upon looking upward discovered what appeared to be an immense ball of fire descending toward the earth. Its course was so rapid that before he had recovered from his astonishment the mass fell into the sea, apparently about half a mile from the shore. A loud, hissing noise, followed by a sharp explosion, accompanied the fall, and so frightened the horse which the reporter was driving that his whole attention for the next five minutes was directed toward the unruly animal, but he noticed that the tail of the meteor, as it is called, or, more properly, the combustion occasioned by the immense velocity with which the stone traveled through our atmosphere, remained visible for about two minutes. From the brilliancy and area of the fire surrounding the falling stone, and the splash occasioned by its sudden immersion, it is certain that the aerolite must have been of immense size, although, of course, no estimate could be made with any accuracy during the few seconds the aerolite was visible.—*San Francisco Chronicle.*

The California Earthquakes.—The San Francisco *Alta* of December 21, says: "Seven distinct earthquake shocks—one of them so severe that, according to the local paper, the 'buildings labored like a ship at sea'—visited the town of Silver Mountain, Alpine County, within half an hour in the early evening of the 11th inst., but did no damage. We have no report yet that these shocks were felt elsewhere. Silver Mountain, which has now, so far as we remember, had its first experience of this kind, is about 6,000 feet above the level of the sea, beyond the summit of the Sierra, 150 miles in a direct line eastward from San Francisco, and 200 miles northward from Owen Lake, which last place, on account of the volcanic character of its geological formation and its severe earthquake of March 26, 1872, has the reputation of being rather shaky. From 1851 to 1868 earthquakes were common in this city—so frequent, indeed, that one observer, who made a lengthy report on them to the San Francisco Academy of Sciences, declared that for a considerable period there was more than one a day on an average—and rare in the mountains; but in the last eight years the coast from Monterey northward has been comparatively exempt, while the region east of the Sierra, from Owen Lake to Virginia City, has had the most notable visitations, though no one place has had many. Italy, Greece, Asia Minor, and California are all classical as earthquake countries; but the last will doubtless be as secure for its inhabitants generally as the others have been for thousands of years."

AGRICULTURE AND HORTICULTURE.

CROPS OF THE COUNTRY.

From the December report of the Department of Agriculture we extract as follows on the crops of the year:

"The returns of November make the corn crop only two per cent. short of the great crop last year, and fully fifty per cent greater than the crop of 1874. The aggregate is 1,295,000,000 bushels. Less than one per cent. of this is raised in New England, scarcely six per cent. in the Middle States, twenty in the Southern, forty-four in the Ohio basin and twenty-nine west of the Mississippi. The South raises 10,000,000 more bushels than last year; New England 300,000 more, and there is less in the Middle and Western States. The Southern States stood twenty-three in 1870 to twenty now. In 1850 the West produced thirty-two per cent, of the crop; in 1860 thirty-two per cent. The states of the Ohio basin, with Michigan and Wisconsin, stood thirty-nine per cent. in 1850, forty-one in 1860, and forty-four in 1870 and 1876. Minnesota, Iowa, Missouri, Kansas and Nebraska produced seven per cent. of the entire crop in 1850, fifteen per cent. in 1860, twenty-one per cent. in 1870, and twenty-eight per cent. in 1876. The increase in Kansas has been very rapid of late, nearly equaling in amount this year the crop of Missouri. Iowa grows more than four-tenths of the crop in this section. Illinois produced about 250,000,000 bushels this year; Iowa, 155,000,000 , Ohio, Indiana, Missouri and Kansas rank next, in order named. There has been an aggregate increase in area of production of about 2,000,000 acres.

"The potato crop falls considerably below an average. Drought is given as the principal cause of diminishing yield, though beetles, grasshoppers, blight, rust and rot had especial localities to themselves. There is also a general decline in quality.

"Of other crops, we note that the entire production of hay is eight per cent. above last year, and five per cent. better in quality; beans, about seven per cent. less than last year; buckwheat, eight per cent. less; sorghum, fourteen per cent. above; tobacco, not quite so favorable as last year. The decrease is in Massachusetts, Connecticut, New York, Maryland, Virginia, North Carolina and Tennessee; Pennsylvania, Ohio, Indiana and Illinois report an increase, that of Ohio, Indiana and Illinois being very large. The quality of the entire crop is about as last year.

"In fruit, apples exceed last year's crop in all the states except Maine, Vermont, New Jersey, Delaware, Virginia, Missouri, and in all the Southern States except South Carolina. The only complaint in the other states is superabundance, which diminishes the value greatly. Pears fall below last year, the blight being the principal cause. Grapes, somewhat less than last year, mildew and rot being principal agents in the decrease.

"The acreage of winter wheat put in last fall increased five per cent. over previous year, and the condition appears to be about ten per cent. above average, taking the entire country. The fly has done considerable damage in several counties of Pennsylvania, especially in early sown wheat. With the exception of South Carolina, the South Atlantic and Gulf States are below average in condition. West Virginia and Kentucky, and all the states north of the Ohio River, show a superior condition, especially Ohio and Indiana. In some western localities grasshoppers destroyed first sowing, necessitating a second, which has started very imperfectly. In rye, the average is about with that of last year, and condition an average."

BEE CULTURE.

Prof. Cook sends us an extended report of the bee-keeping experience during the year at the Michigan Agricultural College, the main points of which we summarize. In the spring the apiary grounds were surrounded by numerous honey-producing shrubs and trees, among them bass-wood, locust, crab-apple, shad-bush, &c. Most of these have done well—a few have died. These have been kept mulched, and the ground about them well spaded all the season. More evergreens have also been set out, some for a wind-break, others for shade for bees, and some Concord grapevines and Virginia creeper, for shade. Some of the latter has been set about the house, that it may climb upon it, and has already made a fine growth. Several kinds of bee-plants of more or less repute were also planted, the following of which have done well, and all yielded bloom except the two first, which will not bloom till another season: Yellow trefoil clover, yellow

Bokhara clover, mignonette, black mustard, Chinese mustard, borage, common and silver-leaf buckwheat, common and Chinese sunflower, and Rocky Mountain bee-plant.

The colonies were not permitted to swarm, but artificial swarming or dividing was practiced. Three colonies left without leave-taking, which loss might have been prevented by "previously cropping the queen's wings." The professor says he has proved, what reason and a knowledge of the natural history of the honey-bee would discover, that natural swarming is always suffered at a great sacrifice. This insures a queenless colony for nearly or generally quite two weeks, which is equivalent to the loss of a fair colony of bees, as a good fertile young queen will start a fair colony in this time, especially as this is generally at the time of the best honey season of all the year. The great value of the extractor was again demonstrated during the unusual honey yield of August and September. Although the bees had plenty of room in the supers—both boxes and frames—still they would fill up the brood space as fast as the bees came forth, so as utterly to preclude breeding. By extracting, the brood-chamber was kept replete with brood, while by omitting the same, breeding stopped entirely. It was found, too, that this sent the queen into the supers, where she would lay if there was a possible chance; whereas she remained below entirely when room was given her in the brood-chamber.

The fact that there was no brood reared in colonies destitute of pollen till the bees had gathered and stored some seems to demonstrate that pollen is an essential element of the feed of the larvæ, though it is not required by the mature bees. The rapid increase of brood in the spring would also indicate that it is as well, if not best, that the bees have no pollen till they can fly out in the spring. The observations of the past spring, sustained also by those of 1874, show that bees are pretty apt to be able to gather pollen as soon as it is best for them to fly in spring—by the middle of April—and that feeding meal is unnecessary. Evergreens for shading the colonies, especially Norway spruce, not only serve an excellent purpose, but can be trimmed so as to make the apiary grounds very attractive from their beauty, and are to be strongly recommended. Sawdust about the hives, underlaid with brick, by keeping the grass down, serves an excellent purpose, as it enables one to see at once any bees that fall upon it, and thus insures against loss of queen.

As all the bees wintered so well during the past winter, no special difference could be seen between those fed late the previous fall and those that were not. All bred so late as to vitiate the experiment. The experience of the summer shows that the following honey-plants not only yield well, but that they bloom well early in July till autumn, covering a period when there is a dearth of native honey-bloom: Mignonette, borage, and black mustard. Chinese mustard is inferior to black mustard. It blooms early, and the bloom fades away much sooner. Sun-flowers are unworthy cultivation, while the Rocky Mountain bee-plant blooms too late to be valuable where there is plenty of fall bloom native to the region. With no native bloom to furnish autumn honey, it would be valuable. All of the above do well on light sandy soil. The autumn experienec proved that golden-rod honey, though rather dark, is of very superior flavor. Several good judges have pronounced it superior even to linn or white clover.—*N. Y. Tribune.*

GRAPE PRUNING.—People have been befogged and bewildered by reading grape books and articles on grape culture, so much so that many are fearful to apply the knife or use common sense in pruning. A variety that may require very heavy pruning on one kind of soil naturally rich or highly manured, may require but little on other soil not so rich or in such good condition. There is no better season for pruning the grape than the present month, and as pruned it is well to lay the canes on the ground and allow them to remain there until spring. For a trellis or arbor, or side of buildings, it is well to allow about two or three leaders to grow, and this month cut back one-third to one-half of past season's growth, if it is desirable to confine their growth within certain limits, but if there is a large space to cover, do not cut back. Cut the side granches that grow out from these leaders back to within a foot of the leader, unless the leader is very strong, and the side branches also, and in that case it may be cut back at half the length to reach the next leader. There can not be a better rule applied to all vines than to trim out any part of the vine that is branching out too freely, and train canes where the space is not sufficiently covered. A little practice is the best school, and common sense the best teacher. If there be trees near by, allow a cane to run into such. Every two or three years allow two or three canes to grow from near the base of vines, and cut out all the old canes, and, having trained all these new canes half way between them, or allowed them to run along near the ground, they can take the place of the old canes as they are cut out. Vines that were set a year ago last spring, and have made a good growth of two or three canes, with small side branches, should have these branches cut back with two or three eyes of the main cane, and the next year allow to grow from these stub side branches wherever needed to fill up vacancies."—*Fruit Recorder.*

SCIENTIFIC MISCELLANY.

SPONTANEOUS COMBUSTION IN COAL CARGOES.

Some years since a royal commission was appointed in Great Britain to inquire into the causes of spontaneous combustion of coal in ships, and into the remedies possible to adopt for providing against such occurrences.

The first efforts of the commission were directed to the collection of information bearing on the general condition of the export coal trade, the methods of shipment employed in different parts of the country, the means of ventilation adopted and the particulars of the casualties that had occurred so far as obtainable.

The results of this inquiry showed an export coal trade increasing from 42,000,000 tons in 1873 to 14,000,000 in 1875; that by far the greatest proportion of casualties occur on long voyages, and that they are most frequent in cases where the largest quantities are shipped in one bulk. The proportion of casualties to quantity varied from one-quarter per cent. of cargoes under 500 tons to nine per cent. in cargoes of over 2,000 tons, and of cargoes destined for California nine casualties occurred out of fifty-four shipments of 500 tons, while out of five ships with cargoes of over 2,000 tons, two were destroyed.

It was also shown, conclusively, that ventilation, instead of being a protection to such vessels, was a dangerous influence. The Euxine, Oliver Cromwell, Calcutta and Cora were loaded under the tips, at Newcastle, at the same time, with the same coal and from the same seam, sometimes one ship being under the tip and sometimes another. Each carried from 1,500 to 2,000 tons of coal. The first three, which were well ventilated, were bound for Aden, and the last, which was not ventilated at all, for Bombay. The Euxine, Calcutta and Oliver Cromwell were all totally destroyed by spontaneous combustion, while the Cora carried her cargo safely to Bombay. Numerous instances of similar character are reported, and the commission concluded that the pressure recently put upon ship owners and masters to adopt systems of thorough ventilation for coal cargoes increased the risks.

TALKING BY TELEGRAPH.

The newly discovered science of telephony has created much interest among scientific men and electricians lately, and is likely to produce a revolution in the commercial world if the wonderful experiments in talking and singing, now being made between Salem and Boston, prove successful when made under the ordinary conditions of electric telegraphing. The invention is thus described in the *Graphic:*

The telephone consists of a powerful, compound, permanent magnet, to the poles of which are attached ordinary coils of insulated wire. In front of the poles, surrounded by the coils of wire, is placed a diaphragm of iron, while a mouth-piece to concentrate the sound upon this diaphragm substantially completes the arrangement. When the human voice causes the sensitive diaphragm to vibrate, electrical undulations are induced in the coils surrounding the magnets in precisely the same manner as the undulations of the air are produced by the voice. These undulations then travel through the wire, and, passing through the coils of an instrument of similar construction at a longer or shorter distance, as the case may be, are again transformed into air undulations by the diaphragm of the instrument. It will be borne in mind that the voltaic battery is dispensed with entirely, and all that is needed for transmitting the voice sounds are the instruments and the telegraph wire. In this connection a remarkable peculiarity of the telephone is that a practiced ear is able to distinguish the voices that speak through the instrument. The inventor claims that the electric wave of the telephone can be perfected to render free and easy the sounds generated by the human voice to any length.

It is well known that the expense and trouble of batteries and keeping them in order has been one of the main items in the account of telegraphing, and with the present system expert operators are required. Under the system of telephony the cost of constructing the line and putting in the instruments is all, and the affair is permanent so long as the wires and poles shall last.

Respecting the adaptation of the invention to long distances, the late experiments warrant the belief that it can be made to answer all the purposes of the telegraph either under the ocean or across the land. The artificial resistance employed in the experiment between Boston and Salem, as already hinted, was much greater than an equivalent of the length of the wire between New York and San Francisco of the Atlantic cable. In fact, the inventors hope soon to talk through the cable, and send their compliments to Queen Victoria.

DEFENCE OF SCIENCE IN AMERICA.

In many of the addresses that have been made during the past summer, on the Centennial occasion, the shortcomings of the United States in extending the boundaries of scientific knowledge, especially in the physical and chemical departments, have been set forth. "We must acknowledge with shame our inferiority to other people," says one. "We have done nothing," says another. Well, if all this be true, we ought perhaps look to the condition of our colleges for an explanation. But we must not forget that many of these humiliating accusations are made by persons who are not of authority in the matter; who, because they are ignorant of what has been done, think that nothing has been done. They mistake what is merely a blank in their own information for a blank reality. In their alacrity to depreciate the merit of their own country, a most unpatriotic alacrity, they would have us confess that for the last century we have been living on the reputation of Franklin and his thunder-rod.

Perhaps, then, we may without vanity recall some facts that may relieve us in a measure from the weight of this heavy accusation. We have sent out expeditions of exploration both to the Arctic and Antarctic seas. We have submitted our own coast to an hydrographic and geodesic survey, not excelled in exactness and extent by any similar works elsewhere. In the accomplishment of this we have been compelled to solve many physical problems of the greatest delicacy and highest importance, and we have done it successfully. The measuring-rods with which the three great base-lines of Maine, Long Island, Georgia, were determined, and their beautiful mechanical appliances, have exacted the publicly-expressed admiration of some of the greatest European philosophers, and the conduct of that survey their unstinted applause. We have instituted geological surveys of many of our States and much of our Territories, and have been rewarded not merely by manifold local benefits, but also by the higher honor of extending very greatly the boundaries of that noble science. At an enormous annual cost we have maintained a meterological signal system, which I think is not equaled and certainly is not surpassed in the world. Should it be said that selfish interests have been mixed up with some of these undertakings, we may demand whether there was any selfishness in the survey of the Dead Sea? Was there any selfishness in that mission which a citizen of New York sent to equatorial Africa for the finding and relief of Livingstone, any in the astronomical expedition to South America, any in that to the valley of the Amazon? Was there any in the sending out of parties for the observation of the total eclipses of the sun? It was by American astronomers that the true character of his corona was first determined. Was there any in the seven expeditions that were dispatched for observing the transit of Venus? Was it not here that the bi-partition of Bela's comet was first detected, here that the eighth satellite of Saturn was discovered, here that the dusky ring of that planet, which had escaped the penetrating eye of Herschel and all the great European astronomers, was first seen? Was it not by an American telescope that the companion of Sirius, the brightest star in the heavens, was revealed, and the mathematical prediction of the cause of his perturbations verified? Was it not by a Yale College professor that the showers of shooting-stars were first scientifically discussed, on the occasion of the grand American display of that meteoric phenomenon in 1833? Did we not join the investigations respecting terrestrial magnetism instituted by European governments at the suggestion of Humboldt, and contribute our quota to the results obtained? Did not the Congress of the United States vote a money-grant to carry into effect the invention of the electric telegraph? Does not the published flora of the United States show that something has been done in botany? Have not very important investigations been made here on the induction of magnetism in iron, the effect of magnetic currents on one another, the translation of quantity into intensity, and the converse? Was it not here that the radiations of incandescence were first investigated, the connection of increasing temperature with increasing refrangibility shown, the distribution of light, heat, and chemical activity in the solar spectrum ascertained, and some of the fundamental facts in spectrum analysis developed long before general attention was given to that subject in Europe? Here the first photograph of the moon was taken, here the first of the diffraction spectrums was produced, here the first portraits of the human face were made—an experiment that has given rise to an important industrial art!

Of our own special science, chemistry, it may be affirmed that nowhere are its most advanced ideas, its new conceptions, better understood or more eagerly received. But how useless would it be for me to attempt a description in these few moments of what Prof. Silliman, in the work to which I have already referred, found that he could not include on more than one hundred closely-printed pages, though he proposed merely to give the names of American chemists and the titles of their works! It would be equally useless and indeed an invidious task to offer a selection; but this may be said, that among the more prominent memoirs there are many not inferior to the foremost that the chemical literature of Europe can present. How unsatisfactory, then, is this brief statement I have made of what might be justly claimed for American science! Had it been ten times as long, and far more forcibly offered, it would still have fallen short of completeness. I still should have been open to the accusation of not having done justice to the subject.

Have those who gloat over the shortcomings of American science ever examined the Coast Survey reports, those of the Naval Observatory, the Smithsonian contributions, those of the American Association for the Advancement of Science, the proceedings of the American Academy of Arts and Science, those of the American Philosophical Society, the Lyceum of Natural History, and our leading scientific periodicals? Have they ever looked at the numerous reports published by the authority of Congress on geographical, geological, engineering and other subjects—reports often in imposing quartos magnificently illustrated?—*Prof. J. W. Draper, in Popular Science Monthly.*

THE HELIOTYPE PROCESS.

The principle on which the heliotype process is based was discovered by M. Poitevin, a Frenchman, more than twenty years ago, but the working of it as described by him was not found to be practicable. Various modifications have been suggested from time to time with more or less success. In the heliotype process, beyond the actual principle, every part, step and method, is peculiar to itself, and has been protected by patents in Europe and the United States.

The principle above referred to is, that gelatine, which ordinarily absorbs water very readily, when treated with a bi-chromate and exposed to the action of light loses this property and becomes water-proof to a greater or less degree, according as the action of the light is greater or less. So that by allowing light to act through a photographic negative on a sheet of bi-chromatized gelatine, we can communicate to the gelatine the same property which is given to a lithographic stone, by drawing upon it with greasy ink; that is to say, where the light has acted, just as where greasy ink has been used, water is repelled; where light has not acted, water is absorbed and grease repelled; and where light has partly acted, as in the half-tones of a negative, water is partly absorbed, and grease partly repelled. This important fact must also be noted, viz: that the gelatine sheet thus treated has capabilities far beyond those of the lithographic stone, the latter being able to deal only with the contrasts of black and white (or *lines*), while the gelatine is able to render all the infinite gradations of shade (or *half-tints*) which appears in any photographic negatives taken from nature or life. Ordinary gelatine is dissolved in warm water, and a sufficient quantity of *bi-chromate of potash* is added to render it sensitive to light, and of alum to make it very hard and durable. This solution is poured on a level plate, previously rubbed over with wax, and is dried by means of heat. As soon as dry, or when required for use, the sheet of gelatine is stripped from the plate, and printed under a photographic negative. When the picture appears sufficiently plainly, the sheet of gelatine is taken from under the negative, and made to adhere to a metal plate. The method of adhesion used is that of atmospheric pressure. The sheet of gelatine and the metal plate are put together under water; as much of the water as possible is got rid off from between the two surfaces; the gelatine absorbs the remainder, so that a vacuum is created, and the picture is thus attached to the plate by the weight of the atmosphere. The superfluous chemicals are soaked out with water, and the plate, with the printing surface of gelatine attached, is placed on an ordinary platen printing-press, and inked up with ordinary ink. In printing, it is necessary occasionally to dampen the plate with water. A mask of paper is used to secure white margins for the prints; and the impression is then pulled, and is ready for issue. Two or more inks are sometimes used in the production of one picture, as it is found that, where the light has acted deeply, a stiff ink is required; but, where it has acted not so deeply,—that is, in the half-tones,—a thinner ink may be used. So that a stiff ink is first used for the shadows, and a thinner ink afterward for the half-tones. In this manner three or four inks may be used in printing one impression. The effect of India or other colored tint is obtained by using, instead of ordinary water for dampening the plate, water with some color in it. The paper absorbs a certain amount of water out of the plate, and with it a certain amount of color. The ordinary rollers are not found to be satisfactory; and a mixture of gelatine, glycerine, and castor oil is used.

By a modification of the process and *from subjects in line*, electrotypes are produced capable of being worked on any printing-press with or without type.

T. A. Edison, in an article in the *American Chemist*, has the following Laboratory Notes, which are of much interest, and may be found valuable:

"Hard rubber or vulcanite, placed for several weeks in nitrobenzol, becomes soft and pliable like leather, and easily broken.

"The vapor of chloral hydrate is a solvent of cellulose. I have found the corks of bottles containing the crystals eaten away to the depth of a quarter of an inch, the cork being resolved into a black semi-liquid. Certain kinds of tissue paper are partially dissolved in time, if thrown in a bottle containing the crystals.

"A very difficult substance to dissolve is gum copal. I have found that aniline oil dissolves it with great facility.

"Hyposulphite of soda is apparently soluble to a considerable extent in spirits of turpentine. Large crystals of "hypo" melt down to a liquid after several weeks, and if the bottle be shaken, partially disappear. The turpentine smell nearly disappears.

"The vapors of iodine, in the course of several months, will penetrate deeply into lumps of beeswax.

"If to a solution of bisulphide of carbon there be added twice its bulk of potassic hydrate in sticks, and the bottle be well sealed, the whole will, in two months, become an intense reddish, syrupy liquid, with scarcely any free bisulphide of carbon.

THE curious discovery, says the *Scientific American*, is announced by Prof. P. B. Wilson, of Baltimore, that minutely pulverized silica is taken up in a free state by plants from the soil, and that such silica is assimilated without chemical or other change. The experiment consisted in fertilizing a field of wheat with the infusorial earth found near Richmond, Virginia. The earth, it is well known, consists of shells of microscopic marine insects, known as diatoms, which, under strong magnifying power, reveal many beautiful forms that have been resolved, classified and named. After the wheat was grown, Prof. Wilson treated the straw with nitric acid, subjected the remains to microscopic test, and found therein the same kind of shells or diatoms that are present in the Richmond earth, except that the large-sized shells were absent, showing that only silica particles below a certain degree of fineness can ascend the sap pores of the plant.

THE French have introduced a new substitute for gold. It consists of 100 parts by weight of pure copper, 14 zinc or tin, 6 magnesia, 3.6 sal ammoniac, 1.8 burnt limestone, and 9 cream of tartar. The copper is first melted, then the magnesia, sal-ammoniac, limestone and cream of tartar, in powder, are gradually added separately. The whole is kept stirred for half an hour, the zinc or tin being dropped in piece by piece, the stirring being kept up till they melt. Last of all the crucible is covered and the mass kept in fusion for thirty-five minutes. The scum being removed, the metal is poured into moulds. The alloy is fine-grained, malleable, and takes a high polish. It does not oxidize.

BLUE LAMP CHIMNEYS.—Noted oculists, for instance Gräft, Arlt and Stellwag-Carion, recommend either blue, bluish gray or smoke colored glasses as a protection for weak eyes against the unpleasant effect of red, orange and yellow light. On the same principle, the trying reddish-yellow light of candles, lamps and gas, on normal eyes as well as weak ones, can be pleasantly modified by the use of blue chimneys or globes (or at least of shades for the reflection of the light) colored a light ultramarine blue. A remarkably near approach to a light as agreeable as day light is said to be produced by a petroleum lamp with a round wick and a light-blue chimney of twice the usual length, the latter causing so great a draught that the petroleum burns with a nearly pure white flame.

EDITORIAL NOTES.

THE science-loving portion of our community have been favored with quite a number of lectures and essays during the past few weeks. Under the auspices of the Academy of Science and other associations we have listened to Professors Broadhead, Mudge, Teed and Tice, as well as to Doctors Fee and Shaw and Judge West.

The organization of the Academy of Science in this city last year has proved a decided stimulus to investigation and research in many directions, and if properly managed and maintained, will accomplish much good in the future. There is no region in the whole country where objects of geological interest abound more, nor, from recent discoveries, where archæològical remains are more numerous or of greater interest, and the Academy will furnish a nucleus about which scientific men from every direction will gather for purposes of investigation and comparison. It is an institution which should be aided and fostered by all classes of our citizens as a matter of local pride, if for no other reason. Evéry one can in the course of the year contribute something to assist in building it up, if it be nothing more than a few fossils, minerals, books, or even a few dollars in money.

THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS, with a study of the relations of living and extinct faunas as elucidating the past changes of the earth's surface. By ALFRED RUSSEL WALLACE. Two vols., with maps and illustrations. New York: Harper & Brothers. 1110 pages. For sale by Matt Foster & Co. $10.00.

The object of this most valuable and interesting work, the only one, as far as we know, that has ever been written on the subject without any attempt to wrest the facts into a shape corroborative of some preconceived hypothesis, can best be shown by quoting the author's own language in his preface: "My object has been to show the important bearing of researches into the natural history of every part of the world upon the study of its past history. An accurate knowledge of any groups of birds or of insects, and of their geographical distribution, may enable us to map out the islands and continents of a former epoch,—the amount of difference that exists between the animals of adjacent districts being closely related to preceding geological changes. By the collection of such minute facts alone can we hope to fill up a great gap in the past history of the earth as revealed by geology, and obtain some indications of the existence of those ancient lands which now lie buried beneath the ocean and have left us nothing but these living records of their former existence."

The book is divided into four parts: First, The Principles and General Phenomena of Distribution; Second, The Distribution of Extinct Animals;

Third, Zoological Goography; Fourth, Geographical Zoology. Each of these is illustrated with maps and engravings, but, as the author remarks, they all belong more immediately to Part three, which is handled rather more popularly than either of the others, and is in fact the summing up or conclusion of the work, and should really be read after Part four.

What is to be admired, perhaps, more than any other feature of the book, taken in comparison with many other scientific works, is the absence of any slighting allusion to the Bible or the views of theological writers. The author in this and in other works has adopted the theory that by slow and gradual development the various species of animals now found on the earth have been produced from those preceding them, but he differs from Darwin in admitting that man's physical and intellectual endowments can only be accounted for by acknowledging a special creative act of the Almighty. No reader, however straight-laced his orthodoxy, need apprehend finding any attempt to draw him away from his faith. He will merely find straightforward statements, based strictly and fairly upon facts discovered by the author himself and other distinguished naturalists, and he will lay the book down after reading it with the conviction that it is the result of careful and laborious research, most skillful and systematic arrangement, and an earnest and honest effort to increase the actual knowledge of the reading public without attempting to influence or bias its judgment.

The mechanical work is most excellent, particularly in the maps and engravings, which equal those of any European publisher.

The Popular Science Monthly. February, 1877. D. Appleton & Co., New York. 128 pages. 50c.

This ably conducted journal has reached nearly to the end of its fifth year, and still maintains its original high character and standing as a connecting medium between the highest branches of exact science and the science of common things. The present number contains popular articles on Astronomy, Chemistry, Education, Geology and Engineering, by the best writers of the age, while the editorial department consists of literary notices of late works and a closing summary of current events of marked interest to all classes of scientific readers. We expect from time to time to avail ourselves of this valuable periodical in making up our monthly "Review of Science and Industry," as we have done in this number.

Professor Tice's Meteorological Almanac for the Year 1877, with forecasts based upon astronomical events for every day in the year. Published by the author at St. Louis, Mo. 15c.

We have been favored by the author with a copy of this almanac, and shall publish in each number of the Review a record of the weather during the previous month, side by side with the "indications" of the Signal Service Bureau and the "Forecasts" of the Professor, so that our readers can judge for themselves of the value and accuracy of both sets of observers.

BOOKS, ETC., RECEIVED.—Historical Sketch of Marietta (Ohio) College; Transactions of Medical and Chirurgical Faculty of Maryland; Report of the Commissioners of Agriculture, Washington, D. C.; Eleventh Annual Report of the State Board of Agriculture of the State of Missouri, 1875; Engineering, London, England.

WEATHER RECORD FOR JANUARY, 1877.

Day.	Prof. Tice's Forecasts.	Signal Service "Indications."	Actual Observations at Kansas City.	7 A. M.	2 P. M.	10 P. M.
1	1st to 3d, *F. b., R. t.	cloudy with snow.	clear A.M. cloudy & snow'g P.M	19°	23°	16°
2	Clouding weather.	" " "	clear all day, snow in the East	6	16	8
3	Rain and snow storms.	clear and warmer	clear all day, heavy snow in the South.	12	25	28
4	4 to 6 †R. b., L. t., clearing	" " "	cloudy A. M., clear P. M.	17	32	31
5	weather and probably	cldy, rain or snow	cloudy and warmer.	26	30	26
6	very cold.	" " "	" " snowed in night	24	29	31
7	7 to 9 F. b., R t., clouding	colder " "	clear, snowed nearly all day.	26	18	6
8	and threatening, with	cold and clear.	clear and very cold. Snowing everywhere	—6	10	6
9	rain or snow.	cloudy and cold.	cloudy and warmer A. M. Snowed P. M.	19	30	29
10	10 to 11, R. b., L. t., clear,	warmer with rain or snow	clear A. M., cloudy P. M.	17	30	26
11	or clearing and cold.	cloudy and colder	cloudy all day, N. wind P. M.	24	28	11
12	12 to 15, F. b., R. t., clouding, threatening weather	cold and clear.	cloudy and cold all day.	2	5	0
13		cold and cloudy.	cloudy A. M., clear P. M.	1	20	16
14	with heavy rains and	colder and clear.	cloudy A. M., sprinkled P. M.	17	32	29
15	snows.	cloudy with snow.	sleeting; bad weather all around.	32	20	—3
16	16 to 17, R. b., F. t., clear	" " "	clear and cold all day.	—12	5	4
17	and cold.	" " "	clear A. M., cloudy P. M.	6	33	33
18	18 to 20, F. b., R. t., cloudy	colder with snow.	cloudy and threatening.	30	23	12
19	and threatening with	" " "	" snowed A. M., clear P. M	10	27	28
20	rain and snow.	rain and snow.	clear and cold.	7	15	11
21	21 to 22, R. b., F. t., clear	warmer & cloudy.	clear and pleasant.	14	36	26
22	and cold.	" "	cloudy and clear. Very cold all over country	18	19	7
23	23 to 26, F. b., R t., cloudy	cold and clear.	clear. Snowstorms in Cal.	—1	23	22
24	and threatening with	cloudy with snow.	clear all day.	10	23	17
25	heavy rain or snow	cloudy & warmer.	" " thawing.	16	35	26
26	storms.	clear and "	" " "	16	39	29
27	27 to 28, R. b., F. t., clear	" " "	" " "	24	42	35
28	and cold.	cloudy and "	" " rained P. M.	29	49	38
29	29 to 31, F. b., R. t., clouding and threatening with	colder with snow.	rained A. M., warm S. wind.	48	47	46
30		" " "	cloudy A. M., rained P. M.	47	48	48
31	rain or snow.	" " "	clear and very warm.	35	53	47

* Falling barometer, Rising temperature; † Rising barometer, falling temperature.

As Prof. Tice's forecasts are intended to cover the entire continent he divides the time into periods of three or four days each, because it requires that length of time "for a storm-centre to pass from west to east across the continent." The Signal Service predictions apply to the Upper Mississippi and Lower Missouri Valleys.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

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ARCHÆOLOGY.

DI CESNOLA'S DISCOVERIES AT CURIUM.

Since the year 1866, Gen. Di Cesnola, who was one of New York's distinguished soldiers in the late war, has been exploring the ancient ruins of the island of Cyprus, and four years ago created a high degree of interest and enthusiasm among students and artists by exhibiting, first in England and afterwards in New York, where it was purchased by the trustees of the Metropolitan Museum, a large and varied collection of Cyprian antiquities, which he had brought from the ancient site of Gotgos.

During the ten years of his labors, Gen. Di Cesnola has made excavations at more than thirty different points, making discoveries of greater or less interest and importance to the historian and archæologist, having identified the sites of not less than nine or ten ancient cities which had passed out of the memory and recognition of the world, and discovered the sites of as many as seven ancient towns whose names are as yet unknown. In the latter part of 1876 he arrived in London with another most rare and valuable collection of gold, silver and bronze relics, taken from some subterranean chambers discovered and explored by him at Curium, in 1875. Having failed to sell them to our British cousins, he offered them to the trustees of the Metropolitan Museum, at New York, for $60,000 in gold, an offer which they promptly accepted and secured the amount within a few days by the voluntary subscriptions of zealous and munificent friends of that institution: thus effecting the completion of a unique gallery, which is the finest in the world, and exciting the envy of the old world *savans*.

Harper's Weekly, of January 13, 1877, contains Gen. Di Cesnola's report of his work for the year 1875, which is so interesting that we give nearly the whole of it, in his own peculiar phraseology:

"In the report I sent last year to the Museum I said that probably I would undertake further explorations at Salamis; consequently early in this spring I went there with my diggers for that purpose. According to Porphyrius, Meursius, and other authors, before the arrival of Teucer there existed a city named 'Korona;" and the Greek hero, according to these authors, after the Trojan war, when banished by King Telamon, his father, from the kingdom of Salamis, came to Cyprus with his followers, took possession of 'Korona,' rebaptized it 'Salamis,' and made himself king over it.

"After some weeks of explorations I found nothing which would warrant further excavations at that place.

"In my opinion it will be very difficult hereafter and extraordinary to make any discovery of importance at Salamis, for the reason that I have assured myself that there very extensive excavations have been undertaken at different epochs and for various purposes.

"Under the Lusignan kings, according to a Cypriote writer, excavations were made and continued for nearly two centuries, both at Salamis, Constantia, and elsewhere, in search for architectural remains and sculptures with which to decorate the royal palaces of these Crusader kings; in fact, at Amathus, Cilium, Curium, the two Paphos, and Salamis, great many tombs are visible to-day which were explored very probably at that period. Wherever I explored I convinced myself that others had visited those localities long before me, and therefore I gave up diggings at Salamis.

"More or less the same thing may be said of Constantia, entirely leveled to the ground by the 'Lion-hearted' King Richard, though the city was already for more than a century in decaying condition, and with very few inhabitants. Her building material was used under the Venetian Republic to repair and strengthen the walls of Famagosta, in anticipation of that long siege which she had to sustain from the Turks, and which sealed her fate and that of this island.

"From Salamis, always coasting the sea, I took the direction of Larnaca. In the vicinity of Cape Greco, which Strabo calls 'Pedalium,' I had my tents pitched for several days. East of this promontory, some twenty minutes' walk from it, I discovered the site upon which once existed the city of Leucolla; she owes the honor of being recorded by Strabo for no other reason but for that of having accidentally given the name to the great naval battle fought near her harbor by Demetrius and Ptolemy (B. C. 306).

"Beyond Cape Greco, and always along the sea-shore, after many unsuccessful attempts I succeeded at last to recognize and identify the exact site whereupon was built a Greek city called 'Throni,' which Strabo mentions in his book as if by accident, but leaves us in doubt whether he intended to speak of a city or of a promontory. This spot is called at the present day by the inhabitants 'Torno,' and lies between Cape Greco and Cape Pyla.

"During my pedestrian perambulations in that neighborhood, at the very extreme point of Cape Pyla, not far from the ruins of a circular tower of mediæval construction, at an elevation of about one hundred feet from the sea, I discovered by mere chance a long cavern excavated twenty-seven feet in the rock, which I had the curiosity to enter. To my surprise I found in it a great mass of petrified bones, the larger portion of which appeared to me to be human. They adhere so tenaciously to the walls and pavement of the cavern that it may be said they form an integral part of them. After two hours of hard labor with iron tools we succeeded in detaching a few pieces; some I sent to the Royal Academy of Sciences of Turin, of which I am a member, and the remainder has been packed up in one of the boxes sent to our Museum in New York. A few days later I was conducted to see another such cavern, smaller in size, and only forty minutes' walk from the former. There, also, are great many petrified bones adhering to the pavement, and apparently of the same period of the others. The Christian peasants of the neighborhood are convinced that the bones are those of thirty Christian Greek martyrs. Every year in the month of March they go in procession, headed by their priests, to this cavern, in order to pray on these 'prehistoric bones.'

"On my return to Larnaca, by the desire and at the request of Professor John Ruskin, of London, I superintended some excavations made at Soli for his account; they lasted, however, but a few months, and with the exception of some three or four statuettes, some heads, and several vases, the result has not been brilliant. At Soli, in order to find good things one must remove first from the surface of the soil many tons of earth brought down from the neighboring mountains by the annual rains, and which has accumulated upon those ruins to the height of several yards; and this preparatory work would be both expensive and unprofitable for several months.

"Amathus (called by the Latin poets Amatunta) was one of the oldest Phœnician cities of Cyprus. It was built on the crest and southern slope of a rocky hill, neither very high nor very large, and detached from several others which surrounded it. Traces of a pier, now under water, are still visible near the sea-shore. It was surrounded by a thick wall, the foundation of which I met on the northeast side of the hill after digging a few feet below the surface of the ground. Remains of another wall are also seen around that hill at different places, but it is of a more recent construction than the other, and is probably Byzantine work.

"On the summit of the eminence a French archæologist, Count de Vogne, in 1862, visiting the island, took possession, in the name of France, of an immense stone vase, which is now deposited in the Louvre Museum. Fragments of another similar vase still exist, and are lying a few feet from the spot where the other was for many years standing, and in view of every passer-by.

"Although in the southern slope of the hill of Amathus there are great many tons of stones which have once served to the construction of ancient buildings, yet very seldom are found among these débris any architectural or sculptured remains.

"Nevertheless, during my absence from Cyprus, in 1873, fragments of a colossal statue, cut out of the calcareous stone of the island, were exhumed there. Its style is very archaic. The head has a beard trimmed after the Assyrian fashion. It holds a lion without a head by the hind-legs. It has all the appearance of being the titulary divinity of Amathus, namely, 'Melkart,' the Phœnician Hercules (probably used at a later period for decorating a public fountain, as the head of the lion was cut, and a square hole pierced through the neck of the animal for the introduction of a metal pipe). After great deal of official correspondence between the British consul at this place, who pretended to have claims upon that monument, and the Governor-General of the island, the latter got the best of the argument, and at a cost of nearly $500 in gold it was shipped to Constantinople, and is now deposited in the 'Imperial Ottoman Museum of St. Irene.'

"At Amathus there are different localities where tombs abound, but the greater portion lie along the sea-shore. These tombs are oven-shaped, and excavated in a sandy soil at a depth varying from three to five feet. Most of them contained but one body. The objects therein discovered were glass, always broken, but with beautiful iridescence (this being generally the case when the tombs are near the sea), terra cotta lamps of the first and second century of our era, large amphoræ similar in shape to those found at Pompeii; seldom gold ornaments of any value.

"Another kind of tombs are those, cut in the rock, on the adjacent hills west of Amathus. They are oblong, and cut horizontally in irregular tiers; none are over seven feet in length, and the majority of them measure scarcely six feet. They were all opened centuries ago.

"The third group of tombs is situated in a field northeast of Amathus, encircled by low hills, forming, as it were, a natural amphitheatre, and contain sarcophagi made either of white marble imported from abroad, or of calcareous stone of this island.

"These sepulchres are all built with finely cut stones, and are the handsomest I have discovered in the island. I examined many of them. They are found by digging at a depth of forty to fifty-five feet below the surface of the ground, and it is quite difficult to get at them, as the entrances of these tombs are not all facing in the same direction. Some of them have but a single room, others have two, and some four. Their chambers are all built with large stones, some measuring twenty feet in length, nine feet in width, and three feet in thickness. But their average size is the following: length, fourteen feet; width, seven and a half feet; thickness, two feet.

"These tombs are of two different shapes; one with a flat roof and square walls like the following sketch, the roof in every instance being composed only of three large slabs; and the other, with the roof in the form of what we call in the American army a "wall tent." These tombs, the construction of which must have cost a large amount of money and much labor, probably belonged to the royal and aristocratic families of Amathus. Those of but one room have always one, often two, and sometimes three, sarcophagi inside. When with one only, it is invariably found placed in the centre of the room; when two they are placed to the right and left of the entrance, with their heads toward the wall. When three are found inside, two are placed, as before stated, to the right and left, and the third one near the wall, opposite the door.

"The position of the sarcophagi inside these tombs never varies, whether the latter have one, two or four chambers. In one composed of two rooms, for instance, I found as many as ten sarcophagi. Four sarcophagi were deposited in the first, and six in the second room. Their position was exactly as described before, with this difference, that the five extra sarcophagi were superposed to the other five. All were made of calcareous stone, without any ornament.

"No tombs were discovered with more than four rooms; and of these only two, one of which contained the sculptured sarcophagus of which I sent a photograph to the president of the Metropolitan Museum. The sculptured sarcophagus was in the centre of the inner room facing the entrance, and there lay in a heap, broken to pieces by the Vandals who, centuries ago, had opened this tomb, and being perhaps disappointed in finding the treasure they sought, wreaked their vengeance upon this rare gem of Oriental art and of pure Cypriote manufacture. Fortunately, however, the stone of which it is composed being soft, it is easy to restore it. In the adjacent chambers were two plain sarcophagi, both of which had suffered in like manner. The discovery of this tomb seems to have been due originally to mere chance, as an opening was found pierced through the roof, by which the descent was made.

"At what epoch this occurred it is difficult to determine, though some rude figures traced upon the walls seemingly with lamp smoke, and bearing in one case semblance to a knight, would indicate the presence of soldiers of the army of the Crusaders.

"The roofs of the four rooms are flat, and, as I said elsewhere, each is composed of three large stones. The first, or entrance chamber, is nine feet seven inches high, thirteen feet four inches long, and eight feet three inches wide. The tomb was discovered at a depth of thirty-nine and a half feet from the surface of the soil, the door facing the west. The three lateral chambers are each eight feet nine inches in length, seven feet ten inches in height, and eight feet two inches in width. The sarcophagi in all these tombs were placed on a very fine pavement of square stones, except in one tomb, in which I discovered a beautiful sarcophagus of fine white marble, having sculptured upon it a female head of colossal proportions in early or archaic Greek style—something like the one existing in the museum at New York, but with the difference that this is much finer in every way, and is Greek. In this case the sarcophagus was elevated from the ground, and stood supported upon six flat stones.

"Before leaving Amathus for Curium the removal of this sarcophagus occupied considerable of my time and thought, as with the means at my disposal it was a very difficult undertaking. We were possessed of no pulleys or other machinery for raising such weight, and were obliged, therefore, to rely solely upon ropes and hand force. Ten hours were employed in bringing it to the surface of the ground. It was then placed upon a low cart made expressly for that purpose, and thence dragged slowly by eight oxen and twenty-six men over rough fields strewn with stones.

"Curium was built, like Amathus, on the summit of a rocky elevation, some 300 feet from the level of the sea.

"The Argives, according to Strabo, were the first inhabitants of Curium. After having selected that excellent situation, they cut the rock perpendicularly on the south and east sides in such a manner that at a short distance one believes to be opposite a huge mediæval castle in ruins.

"At the base of the rock, and on the slope of the adjacent hills, there are great many rock-cut tombs, some hemispheric, others like square sepulchral chambers, which have been opened centuries ago.

"The city of Curium, besides having been built, like an eagle's nest, upon an almost inaccessible eminence, had still a Cyclopean wall on the crest of that hill, which formed a belt around the city.

"Curium had three entrances. Those on the south and west sides are yet quite visible; that on the north has disappeared. The most important of these entrances seems to have been the western one, which faced the sea and the fine bay of Curium, because, unlike the others, it was flanked by two square towers, which apparently defended it, as their foundations are connected with those of the Cyclopean wall above named. I had all the débris removed from one of these for the purpose of measuring its foundations. I found them almost square—twenty-five feet by twenty-four.

"If a person enters these ruins from the south entrance, and takes a northern direction, after six or seven minutes' walk he will find himself face to face with a circular structure, which measures in circumference 720 feet. It has to me all the appearance of having been a theatre. In its immediate vicinity a great mass of stones and rubbish covers small square foundations of buildings divided by a street thirty-seven feet wide. There must have been the business portion of the city. The area occupied by Curium was much more extensive than that of Amathus, or 'Paloo Limissò,' as it is called at present by the inhabitants of Cyprus.

"With the exception of the ruins of 'Neo Paphos,' which are mostly Roman, there is no other place in Cyprus which shows upon the surface of the soil such a quantity of débris than Curium. I counted seventeen spots whereupon there are columns, half buried, either of marble or granite, and which are lying there, very probably, in the same position in which they had fallen many centuries ago. Nothing is now seen standing; every thing lies prostrate by time. This city seems to have been destroyed by some convulsion of the earth. Many small mounds of rubbish mark the site of large private dwellings, while larger ones indicate that of public edifices and palaces. For nearly two months I have visited these ruins almost daily. I explored in preference some of those mounds which have columns lying around them, and from fragments of votive offering and statues, I am led to believe that they were small temples or shrines.

"One of these spots attracted more especially my attention. It had eight granite columns half buried near it. In having one removed, while excavating around it, I perceived that the column was lying upon a fine mosaic pavement inlaid with Assyrian and Egyptian patterns, such as the guilloche, the lotus flower, etc., a portion of which I have been able to save for our Museum.

"After all the columns had been removed, I perceived that the mosaic had been badly destroyed by some treasure hunter, who, after having dug about six feet beneath it, evidently gave up the work as unprofitable. I examined that place with great care, and I became convinced that it sounded hollow at several places, especially on the east side of the mosaic. In fact, after reaching the rock some twenty feet deeper, I found a subterranean passage cut in the rock eleven feet long, four and a half feet wide, and four feet high. At one end it must have had communication with the edifice above, though no traces are visible now. At the other end I found a door cut in the solid rock, closed by a stone slab, similar to those usually found in front of the Phœnician tombs in Cyprus. After the stone had been removed, I found an oven-shaped room filled with fine earth, which had percolated through the roof. In the process of removing this earth another doorway was discovered leading into another room, likewise filled to the top with earth. Informed by my chief digger of this occurrence, I descended into the first room to examine the place, and while poking with my foot-rule in a corner, in order to see at what profundity was the pavement, I found a gold bracelet, with several rings and ear-rings of the same metal, all in a pile, as if hidden there purposedly by somebody. This was extraordinary, for when gold ornaments are found in a tomb they are always mixed up with human bones. After this unexpected discovery I ordered the entire earth to be removed from both rooms. Such a thing is very seldom done here when the tomb is composed of one or two rooms only, because when they are found full of earth inside (and this, fortunately, is rather the rule than the exception), it adheres to the roof and walls so tenaciously that it requires a pickaxe to detach it; the diggers therefore prefer to tunnel each room on the right and left of the doorway, and search on the pavement for the contents of the tomb.

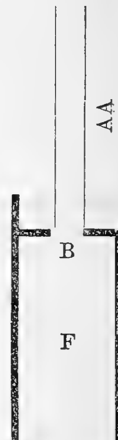
"However, in this case I insisted in having both rooms emptied; and when the second room had some two thousand baskets of earth removed, a third doorway, and, of course, a third room, were discovered similar to the first two; and a week afterward a fourth room was still brought to light.

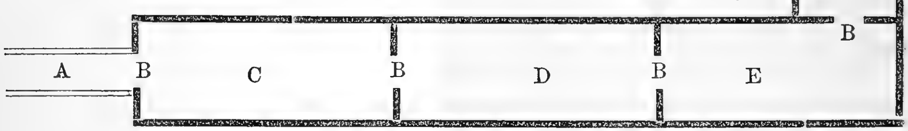
"For more than a month twelve men were working continually, removing the earth from these four rooms, which was carried up to the surface; and when the work was completed, each room had only inside the usual thickness of one foot of earth, between which and the pavement the contents of the tomb are always found.

"At last, after waiting for more than a month, I was able to descend into these four rooms and explore them thoroughly.

"The following diagram will show the position and shape of the rooms. Three of them are on the east and the fourth on the north side of the mosaic pavement that once was above them.

"After having carefully measured each room, and vainly looked for inscriptions, I returned to room 'C,' preceded by my chief digger, and followed by a man carrying a lantern, and we began





A, Passage facing the south, and leading to the rooms—length, 11 feet 4 inches; height, 3 feet 11 inches; width, 4 feet 10 inches. AA, Narrow passage facing west—height, 2½ feet; width, 2 feet. The length beyond 130 feet has been unexplored. B, Doorways communicating with the inner rooms. They measure alike—height, 2 feet 7 inches; width, 3 feet; depth or thickness of doorways, 1 foot 4 inches. C, D, E, Rooms or vaults. These three rooms measure alike—height, 14 feet 6 inches; width, 11 feet; length, 23 feet. F, Room—height, 14 feet; width, 9 feet; length, 21 feet.

the researches on that spot where, by accident, a month before I had discovered the gold ornaments aforesaid. The layer of earth was removed, my chief digger searching in it carefully and delicately with the point of his knife, and passing the earth twice between his fingers, like through a sieve. Soon afterward the mate of the gold bracelet was found, in company with two engraved rings and four pairs of ear-rings. I remarked then, for the first time, the total absence of human remains and of sepulchral vases, and I came to the conclusion that it was not and could not be a tomb. Some time afterward I found out that the building which once existed above these vaults was a temple, and these the subterranean repositories, wherein the priests or priestesses of the temple safely deposited the votive offerings and treasure of the temple during sudden invasion of the island, or in time of war. I was prepared, however, and satisfied, that whatever was to be found therein would be only that which, for some unknown reason, had been left behind. If that place had been found out by some treasure-hunter and ransacked, the stone slab would not have been replaced before the entrance door.

"My musings were agreeably cut short by a loud exclamation from my chief digger, who handed to me two large gold armlets weighing about three pounds; but great was my pleasure when I saw upon each of them, beautifully engraved, an inscription in Cypriote characters. I ascended to the surface to examine them more carefully, and I found that both armlets had the same inscription.

"The Cypriote inscriptions found hitherto in the western part of the island are read from left to right, while all the others are read *vice versa*. The inscription on the armlets consists of thirteen letters, divided by a point into two groups, of which the first is the name of a king of Paphos, who seemingly offered the armlets to this shrine of Curium. In the present stage of Cyprian palæography, it would be hazardous to fix a date to this inscription, but from the character of other objects found with them, I am inclined to believe that the inscription on the armlets belongs to an epoch not later than the Persian expedition against Cyprus chronicled by Herodotus. This inscription, which clearly shows that the armlets were the 'votive offering,' or a present of a king of Paphos, confirmed me in my opinion that the building above with the mosaic pavement had been a temple of some importance. During the several days employed in searching room 'C,' I remained continually inside of it. Of the three persons therein I was the least excited, though there was a good excuse for it. At every moment gold ornaments were exhumed, and nothing else. Among them there were many signet-rings, with a movable scarabeus finely cut either in agate, carnelian, jasper, onyx, or other hard stones. Most of the representations engraved upon these scarabei are Egyptian and Assyrian. It would be too tedious were I to describe here one by one all the fine and valuable gold objects I found in room 'C.'

"Suffice to say that, with the exception of three little amphoræ in crystal (as rare and as precious as gold), all the other objects found in said room were of gold. In room 'D' the objects found therein were all silver, and they consist in vases, cups, bowls, pateræ, armlets, bracelets, rings, and earrings. Also a few Babylonian and Assyrian cylinders, three or four of which, with inscriptions in cuneiform characters. Room 'E' contained with the exception of a bronze lamp and a fine chariot in calcareous stone, many fine vases, with statuettes in relief, or with birds painted upon, and also two or three of the so-called Etruscan kind—one Kilis especially, and a Kalpis, are intact, and very fine specimens.

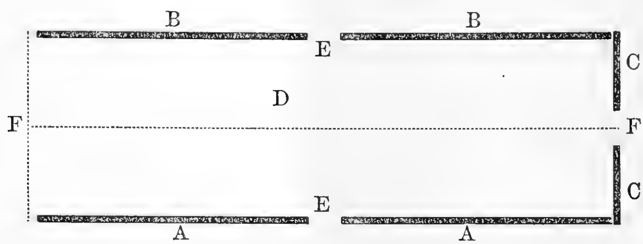
"Room 'F,' which is somewhat smaller than the others, has a doorway on its western wall, which leads to a narrow passage or tunnel, the end of which has been an impossibility for me to find. The foul air inside, the earth percolated through the roof, its narrowness, which does not permit to stand or to turn backward, render the thorough exploration of it a matter of utter impossibility. I entered it with the chief digger, each of us holding a light; but beyond 130 feet the lights went out, and, crab-like, we were obliged to come back, very lucky not to have remained suffocated inside.

"I have mentioned this tunnel before describing the contents of room 'F,' for the reason that the latter was filled with earth removed from the passage, and required several days before it could be explored. In this room every object found is of bronze, copper, and iron, and forms by itself a very interesting and valuable collection. There are many candelabra, some seven feet high, others less than a foot; lamps, mirrors, cups, bowls, vases, etc., etc.; bull's heads, birds, statuettes, etc.

"When I finished the thorough exploration of these four rooms I had the earth replaced inside, the ground above leveled as before (these being the conditions imposed upon me by the owners of the ground and by the imperial firman), and then I prepared to return to Larnaca with all my treasures.

"During the month in which my diggers were employed in removing the earth from the four rooms, I continued to explore superficially the ruins of Curium.

"North of this mosaic pavement, some fifteen minutes' walk, and outside the city walls, there are the ruins of a hippodrome, the walls of which are yet standing; at some places the height is yet twenty-two feet, while at others is scarcely six feet. The following diagram shows the form of the hippodrome (except that the closed end is rounded):



A, B, Sides of the hippodrome. C, End of the hippodrome. D, Axis of the figure. E, Gateways. F, Starting place of the horses and chariots.

"The entrance was facing the city; there are no more traces of the stalls for the chariots, and probably never existed, as I did not find any foundations there. No architectural remains or fragments of statues were discovered among the dèbris, which now fill the area inside.

"The whole length of the hippodrome is 1,296 English feet, measuring eighty-four feet in width. The three gateways measure alike eight feet in width. Compared to that of Olympia, this hippodrome was insignificant, its size being scarcely one-fourth of the former.

"Beyond the hippodrome, in a northwestern direction, at twenty minutes' distance, are the ruins of the temple of 'Apollo Hylates,' which I explored last year, and mentioned in my report. Near these ruins there is a promontory from which, Strabro says, the ancient priests used to throw into the sea those who touched the altar of Apollo with their hands. I visited it, and I am convinced that the victim was instantaneously killed.

"The entire collection consists of the following objects:

	Pieces.
Marble sarcophagus, with colossal head	1
Stone sarcophagus, full of sculptures	1

Gold, precious stones, cylinders, and scarabei	511
Silver and silver-gilt objects, Cyprus coins, etc	272
Objects in bronze, copper, lead, iron, and coins	440
Objects in alabaster, ivory, marble and serpentine	125
Egyptian, Greek and Roman lamps	555
Terra cotta statuettes—heads, groups, etc	800
Stone statues, bass-reliefs, heads, statuettes, etc	1150
Glassware—ointment cups, bottles, bowls, etc	750
Phœnician, Greek and Roman vases	2400
Cypriote, Phœnician and Greek inscriptions	45
Egyptian blue-glazed idols and armlets	110
Sundry articles—mosaic, etc	50

"My archæological labors in Cyprus are very soon terminated, and I hope before the end of next year to be able to leave this island.

"L. P. Di Cesnola.

"Larnaca, December 23, 1875."

The London *Saturday Review*, in speaking of Gen. Di Cesnola's discoveries, says:

"The tale of the finding of the temple treasure at Curium is like a page from the 'Arabian Nights,' while the story of its brief stay in England is merely a repetition of passages too well known in the history of English collections. After selling his former collection to the trustees of the Metropolitan Museum, in New York, for some $60,000, Gen. Di Cesnola returned to Cyprus and began to excavate on the sites of various buried cities. Salamis, as he says in a letter to a contemporary, yielded him next to nothing, for the Princes of the house of Lusignan had been there before him. Curium seemed less promising; it was a town of which little is known. The Argives founded it, according to a rumor mentioned by Herodotus, though Stephanos of Byzantium holds out for a Phœnician or Syrian eponymous settler. Steasanor, the tyrant of the city, went over to the Persian side, as we learn from Herodotus, in the battle in the plain of Salamis. We also know that Curium was one of the places which furnished decorators and other artists to Esar-Haddon. It is impossible to say how it came to perish so utterly that Gen. Di Cesnola was among the first explorers who identified the site.

"The importance of Cyprus as a link in the history of art has for some years been fully recognized. One of the tributaries of Thothmes III, the island felt Egyptian influences before it came into the hands of Assyrians. Whether the Cyprians were originally a 'Japhetic race,' as Mr. Rawlinson calls them, or not, there were several early colonies of Greeks in the country, and Phœnician factories were not rare, while Greek and Phœnician merchants were constantly coming and going. Now the temple at Curium, if one may judge by the treasures, had been enriched by members of many races for a period of at least one thousand years. Few among the offerings can perhaps be proved to be later than the great golden bracelets which bear, in Cypriote characters, the name of Evandros, King of Paphos, in the seventh century B. C. On the other hand, Assyriologists assign an almost incredibly early date to some of the cylinders, while the official seal of Thothmes III takes us back far enough in all conscience. How Curium fell, and by what means the temple treasure escaped being sacked, we do not know; but at all events it contains the history of the development of art through many centuries.

"The collection has not yet been definitely arranged with any attempt at chronological order, nor will it be in England. When the arrangement is made we shall expect to see the silver and golden bowls taking a prominent and instructive position. There is very little ancient silver in European museums—though, during the last week, much has been found at Mycenæ—because the metal becomes oxidized and of a dull clay color and of clay-like consistency. The peasants are rather in the habit of breaking any silver vessel they may find in digging, in the belief that they are worthless. The Curium treasure, however, includes many vases of elegant shape; but especially remarkable is one golden bowl, which is curiously decorated. Animals with an unmistakable resemblance to reindeer are scratched with much spirit in a band round the inside of the vessel. The style of treatment in another flat vessel is almost exactly that which may be seen in a curious Assyrian plate belonging to the Museum, and representing, as it seems, the visible world. The plate is full of slight elevations, which stand for mountains, and in each hill and valley the figure of a bear, lion or deer is scratched. The bowl from Curium is ornamented in the same style, and it is easy to agree with the theory of Brunn, illustrated lately by Mr. A. S. Murray, that Homer, in describing the shield of Achilles, had work of this sort in his mind. A more elaborate design in silver shows a hero struggling with a genuine Assyrian lion. In other vessels the characteristic ornaments of Assyrian and Egyptian art are, so to speak, interwoven. A mixture of this sort is apparently of the essence of Phœnician art. Homer is full of anecdotes of crafty Phœnician traders, who brought gold and silver work to towns on the seaboard of Hellas, and carried away kidnapped children and slaves. The early Greek designers would thus have the example of a style before them which, though somewhat bastard, and perhaps even debased, was free at least from hieratic restrictions. Cypriote art, on the whole, came nearer to that of the Etrurians than of any other race. It would be difficult to trace the exquisite dignity and comeliness of Greek art to anything learned from without, to anything but the divine gift of the spirit of beauty which transmuted the labored efforts of earlier people into perfection. Still the treasure of Curium does contain a wonderful collection of these efforts, the latest of which are touched with the spirit of Greece. In the immense variety of rings and of other jewelry the dawn of true Greek art may be discerned. Many of the rings are almost barbaric; they are gold circlets, with a revolving seal stone, or silver circlets which are so rusted that the stone can no longer be turned round. It is very curious that the finer the gem or intaglio the coarser and poorer is the setting. The most beautiful gem is no doubt Boreas carrying off Oreithyla—'the most precious example,' says Mr. King, 'of Greek art just emerging from the archaic stage yet brought to light.' One of the feet of Boreas is slightly distorted, it seems, but we must remember that on the chest of Cypselus, according to Pausanias, 'snakes' tails hath he in place of feet.' This grotesque survival gives the chest of Cypselus an earlier date than the Cypriote ring, which indeed is clearly of later execution. Mr. King, whose eminent authority will be acknowledged, speaks in glowing terms of two other gems, which English students are to see no longer. Rings as many and glittering as those of Andvari's hoard in the Saga will be stored in the Metropolitan Museum of New York. As years roll on American ladies will learn that Phœnician is not the European way of pronouncing Venetian, and popular education will thrive immensely.

"We must confess that, though not so instructive as the gems, the necklets, armlets, ear-rings and fibulæ from Curium are even more attractive to the amateur of gold work. The Etruscans never beat the patient granulation which Cyprians lavished on morsels of gold, and we have never seen designs—those of Chimæræ and dragons, for example—so full of spirit and life. The little tortoises on studs are the prettiest of 'totems;' and, in fact it scarcely needs an educated eye to discern the manifold merits of the jewelry of Curium. The bronzes and sculptures have only been unpacked for a short time, and few people have had the good fortune to see them. Report speaks very highly of a sarcophagus, adorned with reliefs from the important myth of Medusa, which some Transatlantic scholar may elucidate at his leisure. The designs have been engraved in the *Revue Archeologique*, and nothing can be more curious than the mixture of Assyrian trees and beasts with thoroughly Greek warriors going to the chase in shields and helmets. The whole collection has been bought by the New York Museum for a sum of about £14,000."

The comments of the English press upon the refusal of the treasury department to ask parliament for the £10,000 demanded by Gen. Di Cesnola for this magnificent collection, are about equally divided between vain regrets at their own loss and rather cynical doubts as to whether the erudition and capability of American scholars are sufficient to appreciate such objects in the requisite degree. While there may be something of truth in this latter suggestion, it must at least be admitted that our movements in this respect are in the right direction, and that the beginning we have made and the zeal displayed by those making them, are the sure forerunners of that erudition, and the foreshadowings of æsthetic tastes which will, within a short time, be capable of appreciating fully even such exquisite and recondite treasures of ancient art.

THE STONE AGE OF NORTH AMERICA.

In the history of North America we can go back by the light of creditable documents to the year 986, when Biarne, the son of Bardson, set sail from Iceland, and, losing his way, came in sight of Newfoundland. Back of the earliest discovery by our race of this continent of North America must lie the history of the Indian. In Mexico traditional historic accounts take us back as far as the sixth century. And, for a still earlier time and its events, we have to penetrate the surface of this continent itself. The earth holds the further answers to these questions. In a story of ancient Greece, we read that there was a dispute as to whether Salamis had formerly belonged to the Athenians or the Megarians. When it was referred to Solon, he caused the graves to be opened. It was found then that their occupants were buried according to the custom of the Athenians, and not of the Megarians. The dead men settled that question. The testimony of the dead Athenians dispensed with the formula of an oath, and was yet accepted. No appeal was necessary after such evidence, just as no statute of limitation could bar a trial of such importance. It was a case of supplementary proceedings that commanded respect.

The earth of this continent shows us that before the Indians there has been a people whom we call Mound-builders—that is, mounds were thrown up here by men whose bones we find in them, lying among rough tools and utensils, and after the mounds we name the race, who, perhaps, were not a different people from the Indians.

But for these mounds we would not know of the men who built them. They are mentioned in no history, human or divine. What was there before the Mound-builder? I would speak to-night of what must have been long before *his* time—of *early*, though perhaps not *earliest*, man in North America. We must know this early man by our experience of his traces.

There was a time when stone-throwing was the occupation of grown men of our own race. Stones were used in the warfare of the Celt and the Roman. We remember that David, a Semite, used a pebble from the brook. And we shall find that men of other races, and before David, resorted to the same weapon for all the purposes which in David's time, and with his race, were partly served by metals. There is not only a parallel to be drawn between our boys and savages in certain ways, but there exists one between these boys of the present and our own men of the past. Just as, when cutting into the crust of the earth, we find the remains of animals and plants which once inhabited its former surfaces, the simpler forms below, the more complex above, so we find the remains of man's tools and implements in the clays and gravels of the last geological period of the globe, and with a like sequence in their character. The oldest and lowest forms of tools are simplest; the newer and nearer to the present surface, the more varied and complex. We have seen that the simplest weapon man could use would be a stone. Even now a wagoner with broken cart looks around naturally for a stone to pound with, and so mend his ways. He picks up a stone on occasion as his ancestors did on most occasions. For the moment he is in the Stone age. And he uses what the earliest man must have undoubtedly used, a stone just as it is. There must have been a time when men picked up such stones as came in their way at the moment with which to throw at animals, to break their food, to injure their fellow-men. Such stones, unaltered by use, can no longer be identified.

It is easy to see how, through long lapses of time, men continued to select stones, with an ever-increasing care as to their shape and size. The best to fling, the surest to hit, the sharpest to cut, were picked out, assorted in leisure moments, stored for future use. The hunter, meeting with game, could find no stone suited to bring it down at the moment, and so came at last to carry this primitive shot about with him in his hunting. The way from such a process, and a mode of improving the best of these stones by an artificial changing of their shape and size, were clearly pointed out by experience. And there must have been a gain in the process to such an inventive tribe. No more were long searches for properly-sized stones necessary. By means of harder stones others were chipped and shaped, and so much time was gained from looking for stones and devoted to obtaining food. And tribes using artificially-shaped stones must have had a superiority over those who relied on what natural stones they found at the moment. They stood in less danger of starvation. In the absence of other remains, the presence of roughly-fashioned stones will be the earliest reliable trace we shall find of the existence of men. In Europe such stones have been found and described by several observers. In North America we owe their discovery to the zeal of Dr. C. C. Abbott, aided in funds for excavation by the Peabody Museum of Archæology, of Cambridge, Massachusetts.

North American rough-stone implements vary little in size and pattern, although, when we examine all the kindred rough-stone implements of the world yet known, we see that, as a class, they become gradually more determinate in their shape and the chipping more regular; they come more into the shape of spear-heads, and, perhaps, large arrow-points. Above the rough-stone implements we find those of polished stone; a departure showing that man was no longer satisfied with his first rude fashioning of his implements. Then we find the metals; and of these copper, being more pliable, is first beaten cold and worked into shape for use. Then the process of smelting and mixing with harder metals, such as iron, came to be employed; and to-day we are doing just what man has always done, improving our tools so that we may better our condition.—Prof. A. R. Grote, *in Popular Science Monthly for March.*

ANCIENT EARTHWORKS IN INDIANA.

Prof. R. T. Brown furnishes the Indianapolis *Journal* with the following account of the visit of the Archæological Society to the wonderful earthworks at Anderson, with a description of the formations:

"The Archæological Association of Indiana are indebted to the C., C., C. and I. Railroad for an excursion car placed at their disposal to visit the ancient earthworks of Madison County, Indiana. About thirty persons availed themselves of the invitation, and spent a day very pleasantly in examining the most curious and wonderful works of antiquity in the State. The earthworks are situated on a high bluff overlooking White River and the country beyond it, and but a few rods north of the Bee Line Railroad at a point three miles east of the City of Anderson. The ground is at present covered with a heavy forest of large trees, and is inclosed by a common rail fence. The principal work is a circular embankment elevated about eight feet above the earth on the outside, and measuring 320 feet in diameter. The earth-wall is sixty-three feet wide at the base, and has a level surface at its summit of about nine feet wide. The ascent from the outside is quite gradual, but when the summit is gained the descent is very steep to the bottom of a ditch eighteen feet below the top of the wall. This ditch is sixty feet wide at the top and encloses a circular plain 138 feet in diameter, in the centre of which is a mound four feet high and fifty feet in diameter. Looking to the south, a few degrees west, is a gateway, or opening in the embankment thirty feet wide, and a pass-way of the same width, and on a level with the original surface of the earth breaks the ditch and makes a level roadway to the inclosed plain and mound. On each side of this gateway the wall rises some two feet above its general level, while at the point directly opposite, for the space of about one hundred feet, the wall is gradually reduced in height about the same amount. The central mound has been opened in two places, but nothing of importance was discovered. A number of large trees are growing on the wall and in the enclosed space. A walnut tree had recently been cut down with a saw, leaving its stump on top of the embankment. This stump showed 217 annual rings, or growths. An oak tree one-third larger than this stands on the embankment, and the remains of a large walnut tree which had fallen, perhaps fifty years since, was observed at another point on the wall. The earth appears to be a sandy clay, with occasionally a pebble or small boulder enclosed. The circle is a perfect one, and the slope of the bank, both inside and out, is very regular and uniform. No modern engineer, with the advantage of our improved implements, could have made a more perfect job.

"Around this great work, at different distances from it, are small inclosures, some of them circular, others irregular in form, but all constructed on the general principle of inclosing a central space by means of an embankment with an inside ditch and open gateway. In some of these the wall is as much as three feet high—in others the elevation is barely perceptible.

"Under the bluff, and near the margin of the river, a number of very strong chalybeate springs break out. These were probably the attractions which invited the unknown builders to this spot.

"About three-quarters of a mile east of this group of works is another large work differing somewhat in shape, but yet constructed substantially on the same principle. This is an imperfect parallelogram rounded at the corners and the two side lines slightly bent inward at the middle. The length of each side wall is one hundred and sixty feet, and the width of the space between them at the ends is seventy-five feet, and seventy feet in the middle. The earth-wall is about four feet above the common level, and twelve feet above the bottom of the ditch. The gateway at the east end of the inclosure is eight feet wide, and an embankment extends across the ditch at the level of the surrounding surface, making a roadway thirty-six feet long. On each side of the entrance of this gate, and at a little distance from it, stands a low mound, and several other imperfect traces of minor work to the south of this, in a cultivated field. Trees probably five hundred years old are growing on the large space inclosed by this work, and the decaying remains of several fallen oaks still larger were observed.

"It is in vain to conjecture when, by whom, or for what purpose these works, at an enormous expense of skill and labor, were constructed. Time and patient investigation may give us the clew.

GEOGRAPHICAL.

THE VALUE OF POLAR EXPEDITIONS.

In view of the very discouraging results of the British Arctic expedition under Captain Nares, some writers are beginning to question whether such expeditions do not serve to demonstrate the vitality, endurance and perseverance of the explorers rather than their ability to achieve the desired objects. Were the mere distancing others in reaching the goal of the geographical point called the North Pole and the settlement of the long vexed question of an open, or a palæocrystic, polar sea all that are to be accomplished by so great an expenditure of labor, money and human suffering, this view of the matter would be correct, and the sooner such explorations were abandoned the better. But these are the least important of all the results looked for by scientific men, who continue to urge the formation of new exploring parties and fresh appropriations for their support. As will be seen by Professor Loomis' letter quoted from below, "there is scarcely a problem relating to the physics of the globe which can be fully understood without a knowledge of the phenomena within the polar regions." The poles and the equator are undoubtedly the most important points on the earth's surface for scientific observation. Meteorologists and astronomers, geologists and students of natural history all acknowledge this, and are eager to see the day when the bold navigators of some nation shall plant its standard on the land, water or ice of that mysterious Pole.

As is well known to all of our readers, Captain Howgate, of the Signal Service Bureau, U. S. army, has proposed a scheme for not only reaching the North Pole, but for making it a permanent point of observation in the future, or at least as long as such observations may be found desirable or valuable. Captain Howgate's plan, which has met with the approval of most scientific men of the day, consists in brief in planting a colony on the shore of Hall's Basin or Lady Franklin's Bay for a period of three years, during which time the party will learn how to live in an Arctic region, familiarize themselves with the country, the seasons, the movements of the ice and other phenomena which will enable them to select the most favorable time for making successful explorations. The scheme contemplates the erection of suitable buildings for the shelter of the party, proper supplies of food, apparel and such other articles as experience proves useful and necessary, to be furnished annually by vessels sent out for the purpose, the employment of certain Esquimaux as guides and hunters, and above all that the men comprising the party shall be energetic, hardy and experienced men, who are to be still further hardened by rigid and intelligent discipline by a competent naval officer and corps of assistants to take the observations and direct smaller expeditions from time to time.

Congress has been petitioned to permit the use of one of the smaller naval vessels and to appropriate the sum of $50,000 for the outfit and maintenance of the expedition, and it is probable that before another year passes the Howgate exploration party will be on its way to Discovery Harbor.

In opposition of the views of Captain Nares, who represents that a sea of ancient and never broken ice lies between the highest attained latitude and the Pole itself, Dr. I. I. Hayes, formerly surgeon to Dr. Kane, declares that the circumpolar sea is always open, that no large body of water like Baffin's or Hudson's bay is ever frozen over, even at the lowest temperatures, and he believes firmly that in 1861 he reached beyond the land belt of ice and with a boat could have gone to the Pole. He states positively that in the Arctics the temperature of the sea water generally remains at about 29°, but even at that temperature it does not freeze, unless the air is perfectly calm, and he further says: "I have seen waves rolling at 50° below zero without a particle of ice in sight."

Hiram J. Penrod, of the Signal Service Bureau, writes to the New York *Graphic* as follows:

"The severity of the climate has been exaggerated. To parties under cover it is not more trying than that at the summit of Mount Washington, in New Hampshire, or of Pike's Peak, Colorado, as stated by a former member of one of Dr. Hayes' expeditions, and who has since served a year on the summit of the last named mountain.

"In this connection attention is invited to the following extracts from official reports. The first is from the report of the Secretary of the Navy and his associates on the results of the Polaris expedition:

"'During the summer the entire extent of both low lands and elevations (at Thank God Harbor, latitude 81 deg. 38 min. north) are bare of both snow and ice, excepting patches here and there in the shade of the rocks. The soil during this period was covered with a more or less dense vegetation of moss, with which several Arctic plants were interspersed, some of them of considerable beauty, but entirely without scent, and many small willows scarcely reaching the dignity of shrubs.

"'Animal life was found to abound, musk oxen being shot at intervals throughout the winter, their food consisting of the moss and other vegetables obtained during this season by scraping off the snow with their hoofs. Wolves, also bears, oxen and other mammals, were repeatedly observed. Geese, ducks and other water fowls, including plover and other wading birds, abounded during the summer, although the species of land birds were comparatively few, including, however, as might have been expected, large numbers of snow partridges. No fish were seen. The waters were, however, found filled to an extraordinary degree with marine intervertebrata, including jelly-fish and shrimps. It was believed by the party that the seals depend upon the latter for their principal subsistence, the seals themselves being very abundant.

"'Numerous insects were observed also, especially several species of butterflies, also flies, bees and insects of like character.'

"In the last dispatch written by Capt. Hall, at his snow encampment on the north side of Newman's Bay, latitude 82 deg. 3 min. north, October 20, 1871, he says:

"'We find this is a much warmer country than we expected. From Cape Alexander the mountains on either side of the Kennedy Channel and Robeson Strait we found entirely bare of snow and ice, with the exception of a glacier that we saw covering about latitude 80 deg. 30. min., east side of the strait, and extending east-northeast as far as can be seen from the mountain by Polaris Bay. We have found that the country abounds with life and seals, game, ducks, musk-cattle, rabbits, wolves, foxes, bears, partridges, etc. Our sealers have shot two seals in the open water while at this encampment.'"

Having referred to the letter of Professor Loomis, of Yale College, to Capt. Howgate, we will close this article by quoting from it that portion in which he points out the almost inestimable advantages of a thorough exploration of the Arctic regions to the scientific and the commercial world.

"In order to estimate the value of the results of these expeditions we should consider what would have been the state of our knowledge of the physics of the globe if no such expeditions had been undertaken. There is scarcely a problem relating to the physics of the globe which can be fully understood without a knowledge of the phenomena within the polar regions. Whatever phenomena we may wish to investigate, it is of special importance to determine its maximum and minimum values, and in nearly all questions of terrestial physics, one or other of these values is found in the neighborhood of this pole. If, for example, we wish to determine the distribution of temperature upon the surface of the globe, it is especially important to determine the extremes of temperature, one of which is to be found near the equator and the other near the poles. If we wish to investigate the system of circulation of the winds, our investigation will be sadly deficient without a knowledge of the phenomena in the polar regions.

"If we wish to study the fluctuations in the pressure of the atmosphere, whether periodical or accidental, we cannot be sure that we understand the phenomena in the middle latitude unless we know what takes place in the polar regions. If we wish to investigate the currents of the ocean, we find indications of currents coming from the polar regions, and it is important to be able to trace these currents to their source. If we wish to investigate the laws of the tides we need observations from every ocean, and observations of the Arctic regions have a special value on account of their distance from the place where the daily tidal wave takes its origin. If we wish to study the phenomena of atmospheric electricity and of the auroral exhibitions, no part of the world is more important than the polar regions. If we wish to study the phenomena or terrestial magnetism, observations in the polar regions have a special value, since it is here the dipping needle assumes a vertical position, and the intensity of the earth's magnetism is the greatest. If we wish to determine the dimensions and figure of the earth, we require to know the length of a degree of latitude where it is greatest, and also where it is least. If we wish to determine how the force of gravity varies in different parts of the world, we require observations of the length of the second's pendulum, both where it is greatest and where it is least. In short, there is no problem connected with the physics of the globe which does not demand observations from the polar regions, and generally the poles and the equator are more important as stations of observations than any other portions of the earth's surface. If the information which has been acquired upon the various subjects in the numerous polar expeditions of the last half century were annihilated, it would leave an immense chasm which would greatly impair the value of the researches which have been made in other parts of the world.

"The subjects to which I have here referred are scientific rather than commercial, but many of them have an important bearing upon questions which affect the commerce of the globe. In the attempts which are now being made by the joint efforts of the principal nations of the globe to determine the laws of storms, if we could have daily observations from a group of stations within the Arctic circle, it is believed that they would prove of the highest value in enabling us to explain the phenomena of the middle latitudes. Every winter upon the eastern side of the Rocky Mountains we find an intensely cold wave moving down from the northward, and spreading over a large portion of the United States. How can we fully understand the cause of the great changes of temperature which so frequently occur during the winter months, unless we know where this cold air comes from; and how can this be determined without fixed stations of observation extending northward even to the polar regions?

"The vast extension of the commerce of the world in recent times and its increased security are due in no small degree to more accurate information respecting the physics of the globe, including such subjects as the mean direction and force of the prevailing winds; the laws of storms; the use of the barometer in giving warning of the approaching violent winds; the surest mode of escaping the violence of a storm when overtaken by a gale; the most advantageous route from one port to another; the direction and velocity of the currents in every ocean; the variation of the magnetic needle in all latitudes, and its changes from year to year; together with many other problems; and most of these investigations have been greatly facilitated by observations which have been made within the Arctic regions. I do not regard it as an exaggeration to claim that the benefits which have resulted both directly and indirectly to the commerce of the world in consequence of polar expeditions are more than equal to all the money which has been expended on the enterprises.

"Is any additional advantage to the commerce of the world to be anticipated from further explorations in the polar regions? Undoubtedly. Precisely what these advantages may prove to be, we cannot certainly pronounce beforehand; but upon most of the questions to which I have already alluded more minute information is needed. The demands of science are by no means satisfied, and we may confidently anticipate that any advance in our scientific knowledge respecting questions connected with the physics of the globe will impart increased security to commerce. If a steamer starting from New York and traveling northward could pass directly over the North Pole through Behring Straits into the Pacific Ocean, it would be a triumph of geographical science, equal to the first discovery of America. Whether such a result will ever be witnessed we cannot safely predict, but past explorations have not shown that such an achievement is impossible. I hope we shall not rest contented while so much that is clearly feasible remains to be done, and until the northern boundary of Greenland has been traced."

RECENT GEOGRAPHICAL RESEARCHES IN THE EAST.

One of the most interesting results of the explorations recently made of ancient historical sites at the East—those, in especial, made memorable in Biblical association—is that presented by Prof. Conder, in his elaborate report on the cave of Adullam, a subject, as is well known, which has engaged the attention of oriental travelers and topographists for so many years and with such diverse conclusions.

Differing from almost all those who have preceded him in this line of investigation, Conder points out that the site of this celebrated cave must satisfy certain conditions in which the caves at Khureitun, the traditional site, and those of the Deir Dubban both appear to fail in one point or other. Adullam was in the Shephelah—it was, in fact, near Jarmuth and Socoh, between Gath and Bethlehem, and was a natural stronghold; its site must, therefore, show the usual indications of an ancient town with rock-cut tombs, good water supply and roads; must have at least one habitable cave, and the modern name must contain the essential letters of the Hebrew, especially the ain.

Singularly enough, Conder appears to be the first one to have ascertained that the conditions named are fulfilled in the site now called Ayd el Mieh, which lies in the upper part of the Wady Sumt or the Valley of Elah. In explanation of the conclusion to which this distinguished traveler has arrived concerning this long-controverted question, he states that on the western slope of the valley named is a place called after a kubbet known as the Wely Mudkor, the latter standing on the north edge of a range which rises five hundred feet above a valley, there a mile broad, the sides of the hill being steep and cut into terraces, and the kubbet surrounded by heaps of stones and ruins of indeterminate date; the rock is scarped and quarried; there are wells and stone troughs, ancient tombs, also roads connecting the place with Hebron, Bethlehem and Tell es Safiyeh, and the name Ayd el Mieh with an ain preserves all the essential letters of the Hebrew, which is a most important fact.

Now, as to the cave, Conder states that there is really no single cavern of vast dimensions and with winding passages, in this locality, as may be found at Khureitun, but a series of small caves, smoke-blackened and still inhabited, or used as stables, and he points out that the peasantry accustomed to live in caves carefully avoid living in those of large size, as being damp and feverish, as well as dreading the bats, scorpions and flies that infest them. If, therefore, this identification be accepted, the adventures of David assume a consistency and clearness not compatible with the character of the old traditional sites which have been described in history and located on maps.

Another important correction in Biblical topography, resulting from these recent researches, and which oriental scholars seem likely to accept as at least plausible, is that which points out that the site—Bethnimrah—hitherto generally considered to be "the place where John baptised," is in fact too far south, one condition being that the place must be within two days' journey of Cana and Nazareth. Recently, all the fords of the Jordan have been examined, and, among them, is one found twenty-five miles from Nazareth, which not only seems to answer all the conditions, but also preserves the name—that is, it is called Makhadhet Abara, the "ford of the crossing-over;' but as Bethabara means the "town of the crossing-over," this identity of name might be met with at any of the fords, so that the identification must be supported on other grounds. Besides the favoring condition in respect to distance, the newly-found site is the ford over which the road down the Wady Jalud to Gilead and the Hauran passes; here the river bed is more open than at other places, the steep banks of the valley are further retired, and a broad space is left, suitable for the collection of the great crowds which followed John the Baptist, and for the performance of the rite administered by him to so great a multitude in one place.

Similarly favorable results appear to have attended the efforts recently put forth to arrive at some more satisfactory determination in regard to the ancient Ashkelon. It will be remembered that, a short time ago, Prof. Pusey, one of the most reliable authorities in matters of archæology, called attention to the fact that, just as there were a Gaza and a Maiumus Gazæ, or "Gaza by the Sea," so there were, in the sixth century at least, an Ascalon and a Maiumas Ascalon, each place having then a bishop of its own; and he also pointed out that Benjamin of Tudela speaks of the present Ascalon as the new town "built by Ezra the priest on the sea shore," four parasangs from the former place of the same name.

And now the interesting fact is brought to light that both of these Ascalons exist still. The ruined Ascalon by the sea shore has been long known and frequently described; but the site just discovered, called Khirbet Ascalon, is in the hills north of Beit Jibrin, near Tell Zakeriyeh. It shows remains of an early Christian church or convent, and a great lintel of stone with a deeply cut cross in the centre, resembling somewhat the cross of Malta, lies on the ground; such lintels are to be found in all that class of ruins which date from the fifth to the seventh century. It is twenty-three miles from the shore, which would seem to agree with the four parasangs measured to Ashdod. From all the evidence gathered, it would appear, therefore, that the Ashkelon of the Bible, of Herod and of the crusaders, are one and the same place, distinguished from an early Christian site of the same name by the title of Ascalon Maiumas. The numerous crusading fortresses in the great plain which was the scene of so many terrible conflicts between the English and Saladin have also been pretty nearly all identified.

But the most valuable contribution lately made to this class of researches in Biblical geography is perhaps due to Porter, the English traveler, and in especial his investigations of the much-disputed site of Pisgah, upon which he throws some light of peculiar importance.

It was discovered by this traveler that the ruins of this memorable place lie on a gentle declivity which descends to the wild ravine of Ayun Musa, while on the south is a steep ascent to a rounded hill which projects boldly from the plateau of Moab and commands an extensive view of Western Palestine, and the name given by the Arabs to this hill is that of Jebel Siaghah, "Mount Siaghah"—a corruption of the Hebrew Pisgah, there being no P in Arabic, but the other radical letters of the Hebrew word are retained in Siaghah. Porter describes the summit of the hill as being a little higher than the table-land which extends up to it, rich in soil, and partially cultivated, a full view of Jeshimon, or Wilderness of Judea, being obtained from it, and the whole topography corresponding exactly with the Biblical narrative in Numbers. From the ruins of Siaghah he also saw, about due west, a round peak, connected with the northwest side of Jebel Siaghah by a low, narrow neck of land. On ascending the peak—some twenty minutes' travel from Siaghah, or a distance of about a mile—there were found the ruins of an old town covering the summit and sides of the hill, including, on the top, the remains of a Roman castle, with a large arched tank in the centre, now nearly filled with stones and broken columns, while outside the castle are ruins of a still older date. The name of both peak and town is Neba or Nebbeh, and the summit is about four hundred feet lower than Jebel Siaghah, but commands a much fuller view of the Jordan valley, the Dead Sea and the Plain of Jericho.

The fact appears to be unquestionable, according to Porter, that this Neba is the town Nebo mentioned by Eusebius as six miles from Heshbon, toward Jericho, a position exactly corresponding with that of these ruins; it is evident, too, from the Scripture narrative, that, in the time of Moses, Nebo was a town which gave its name to a section of the mountain-ridge beside it, and such is the case still. Porter states that he paid special attention to the view from Nebo, and compared it with that described in the account of the death of Moses. In the foreground, he says, far below, lies the whole plain of Jericho, with the valley of the Jordan on the northern shore of the Dead Sea, where the Israelites encamped, then called the plains of Moab; on the north is seen the range of Gilead, as far as its culminating point at Jebel Osha, the ancient Mizpah of Gilead, but all north of that peak, including Hermon, is shut out; on the northwest are visible, through the long vista of the Jordan valley, the heights of Naphtali and southern part of Lebanon; from thence to Hebron the whole outline of Western Palestine is in view, but no part of the Mediterranean is seen. It required but a half hour's ride from Neba, down a difficult zigzag path, to reach Ayun Musa, "the fountains of Moses," which spring up under a great cliff in the bottom of the wild glen to which they give their name; from this fountain the peaks of Siaghah and Neba are both in sight, and the interesting fact presents itself that, even to this day, the names Moses, Pisgah and Nebo still cling to this spot—indeed, it seems highly probable, from the observations made by this sagacious traveler, as well as from other concur-ring evidence, that these fountains of Moses, as they are termed, are identical with Ashdoth Pisgah, "the springs of Pisgah," mentioned in the opening portions of Deuteronomy. If this be so, it furnishes additional confirmation of the faithfulness of Porter's researches in this most interesting field of sacred topography.—*St. Louis Republican.*

THE ISTHMIAN CANAL.

Of all the points in the great Central American isthmus, reaching from Texas to Aspinwall, and dividing the two great oceans, the most desirable for the purpose of a ship canal is that surveyed a few years ago by a United States government expedition, and cutting across the isthmus of Panama at its southern extremity. It is very probable that a route via Lake Nicaragua or the isthmus of Tehuantepec would be cheaper and easier in cutting the proposed canal, but it either would be open to the objection of running a great distance through the territory of people that would hardly permit it to be neutralized or placed under the protection of the commercial nations of the earth, or free from toll, etc., for any lengthened period. The United States would hardly allow of a proposition to place a canal running through any portion of its domain under the control of foreign nations, and no other power can be expected to do this any longer than they are compelled by physical force so to do. Besides, the initiative has already been taken, and the right to cut the canal across the isthmus of Panama has been granted by the Columbian government to French capitalists, and the matter may be regarded as already started. The government of the Columbian Republic requires that it shall have no locks or tunnels, that it shall have a capacity of five to six thousand tons, that, in brief, it shall be a clear and perfect waterway between the two oceans. They also require that it shall be finished in ten years after the date of the formation of the company, and that it shall not cost over one hundred millions of dollars.

The value and necessity of such a canal is recognized all over the world, of which there is hardly a maritime nation that is not more or less interested in it. At present, vessels requiring to reach the Pacific from the Atlantic are compelled to go sixty-two degrees or 4,340 miles to the southward, more than most of them should, perhaps to double back just as far in their course, and then at last, not least, to round the tempestuous promontory of Cape Horn ; or, as in the case of steamers, to thread the dangerous straits that divide the group of Terra del Fuego. There would, therefore, be not only a gain in shortening the passage, but also in the risk from fire, tempests, etc., to which vessels are ordinarily exposed, that would make this canal of the utmost importance to commerce. It would add greatly to the facilities for California commerce. It would shorten the distance to New York by 10,164 nautical miles; that is to say, it would reduce it by two-thirds, and instead of an average voyage taking four months, it would not take more than six weeks. It would shorten the distance to Liverpool by 9,364 nautical miles, and reduce the time of passage to seven or eight weeks, whereas six or eight months are now sometimes taken.

The canal would enormously develop the business and industry of all central and southern South America, which has for so long a time been neglected, mainly on account of its inaccessibility from the centres of civilization, enlightenment and commerce. New and flourishing cities would spring up all along the border of the Pacific; Panama would become one of the great commercial centres of the earth and one of its greatest cities. New fields for the development of capital and the employment of labor would be opened, which otherwise might lie dormant for a quarter of a century. The annual amount of tonnage that may be expected to pass through is 3,000,000 tons, and this will increase rapidly from year to year, as a new way from Europe and the East will have been opened to the western parts of the great American continent, to the islands of the Pacific, Australia and New Zealand, Asia and the rich islands of the Indo-Chinese Archipelago. It will, in fact, be opening the Pacific ocean to civilization and commerce. As a business speculation there is no doubt but that the work would pay handsomely, nay, more than handsomely from the first, but if it never paid a cent and the expense had to be borne by the great nations of the earth, it is a work that should be accomplished.

For San Francisco and the Pacific coast it would, as we have already explained, inaugurate a new era as far as cheap freights and quick passages are concerned, but it would do much more than that. The founding of new towns and cities, the increase in the population of the old ones, and the new regions opened to civilization and commerce by it would be so many customers of ours, and in proportion as they grew so would this city grow too. San Francisco possesses a special interest in this matter, and her people look with eagerness for the inception of this marvelous undertaking which is destined, in a manner, to revolutionize the commerce of the world.—*Journal of Commerce, San Francisco.*

THE PROPOSED TERRITORY OF HURON.

The proposed new territory of Huron contains about 70,000 square miles and 10,000 inhabitants. It is the northern half of Dakota, and is said to embrace one of the best farming regions in the United States. The bill to create the territory has already passed the senate, and will probably pass the house, since there seems to be no serious objection to it. There being no direct means of communication between the northern and the southern portions of Dakota, people in the former section having business at Yankton, the capital, which is located in the southern part of the territory, are frequently compelled to travel hundreds of miles in the dead of winter. The capital of the new territory will be the young but rapidly growing town of Bismarck. Fortunately, at the suggestion of Senator Bogy, the name was changed from Pembina to the more euphonious one of Huron. The latter is an Indian name, while the former is a corruption of two French words.—*Washington Star.*

CHEMISTRY.

BOTH SIDES OF THE BLUE GLASS QUESTION.

In the issues of February 24th and March 3d, 1877, the *Scientific American* attacks the blue glass theories of Gen. Pleasonton in detail, and winds up by saying, "It is hardly necessary to add that in our opinion the use of blue glass, as advocated by Gen. Pleasonton, is devoid of benefit." In order to place the subject before our readers in its entirety, as elaborated and put forth by its assailant and defender in their best and most able manner respectively, we will give the objections proposed by the first and the answer thereto, as nearly in full as our space will allow, beginning with the *Scientific American:*

"On September 26, 1871, Gen. A. J. Pleasonton, of Philadelphia, Pa., obtained a patent for 'utilizing the natural light of the sun transmitted through clear glass, and the blue or electric (!) solar rays transmitted through blue, purple, or violet colored glass, or its equivalent, in the propagation and growth of plants and animals.' In his specification, of which the above constitutes one claim, he states that he has discovered 'special and specific efficacy in the use of this combination of the caloric rays of the sun and the electric blue light in stimulating the glands of the body, the nervous system generally, and the secretive organs of man and animals.' He also states that he finds that vegetation is vastly improved by the transmitted blue light.

"These alleged re-discoveries—for the General only claims to have devised the method of utilizing them—were extensively promulgated through the press early in 1871. Subsequently, in 1876, Gen. Pleasonton published a book on the subject, the volume being appropriately bound in blue and printed in blue ink. Recently public attention has again been called to the subject by a New York daily journal. The peculiar kind of glass in question is known as 'pot-metal blue,' that is, it is stained a bluish violet throughout, and is not clear glass covered with flashings of blue glass. It is used in greenhouses, etc., in connection with clear glass; and in Gen.

Pleasonton's grapery it appears that only every eighth row of panes was blue. Some of the results alleged to have been obtained by exposing animals and plants are as follows: Twenty grape vines, in their second year, after being set out under the blue glass, bore 1,200 pounds of splendid fruit. A very weak Alderney bull calf was in four months developed into a strong and vigorous bull. Heifers when kept under blue glass may safely bear young when eighteen months old. A weak child, weighing but three and a half pounds at birth, weighed at the end of four months twenty-two pounds—the light in this instance having come through blue curtains. Two major generals with rheumatism were cured in three days. A young lady whose hair had come out regained her tresses; and to these must be added various other cures of severe ailments which we have not space here to recapitulate. The above are the alleged facts; and we propose to consider the supposed discovery in the light of previous investigations.

"With reference to the theories of electricity, etc., advanced by Gen. Pleasonton to account for his phenomena, their absurdity is so complete that we shall waste no time over them. The important question in the matter, and the only one in which the public is interested, is whether or not blue glass is capable of producing all or any of the results imputed to its use. In order to clear the way for the examination of the investigations, the records of which we have carefully collected, let us consider first those which Gen. Pleasonton quotes in support of his views. These are (1) Seunebier's researches, which go to show that the blue and violet rays are the most active in determining the decomposition of carbonic acid in plants, and (2) experiments of Dr. Morichini, repeated by Carpa and Ridolfi, proving that violet rays magnetized a small needle. The first statement has been totally disproved. Dr. Von Bezold, in his recent work on color, states the 'chemical processes in plants, as far as they are dependent upon light, are principally caused by the rays of medium and of lower refrangibility. The development of the green color of the chlorophyll, the decomposition of carbonic acid, as well as the formation of starch, etc., in the grains of the chlorophyll, are induced by the red, green, and orange rays.' The blue, violet, and ultra violet rays, the same authority goes on to explain, influence 'the rapidity of growth, compel the so-called zoöspores to move in certain directions, and alter the positions of leaves,' etc. In confirmation of this, we have Sach's experiments in 1872, which show that light, transmitted through the yellow solution of potassium chromate, enables green leaves to decompose over eighty-eight per cent. of carbonic acid; while that passed through blue ammonia copper oxide decomposes less than eight per cent. This proves the superiority of the yellow ray to decompose carbonic acid; and this fact Prof. J. W. Draper discovered a long time ago by the direct use of the spectrum. In still further confirmation, we may cite the investigations of Vogel, Pfeiffer, Selim, and Placentim. The last three have conducted researches in full knowledge of those of Gen. Pleasonton, and their experiments show that yellow rays are more promotive of the evolution of carbon in animals and its absorption in plants than any others in the spectrum, the violet rays having least power in these respects, with the exception of the red rays in the case of animals. The absorption of carbonic acid by plants, and its evolution by animals, we hardly need add, are prime essentials to the growth and health of each. The notion that light possesses a magnetizing power on steel was upset by Niepce de St. Victor, in 1861. After removing every source of error, he 'found it impossible to make one sewing needle, solarized for a very long time under the rays of light concentrated by a strong lens, attract another suspended by a hair, whether the light was white or colored by being made to pass through a violet-colored glass.'

"We can proceed further and even show that violet light is in some respects hurtful to plants. Cailletet for example says, in 1868, that 'light which was passed through a solution of iodine in carbonic disulphide prevents decomposition altogether.' Baudrimont says that 'no colored light permits vegetables to go through all the phases of their evolutions. Violet-colored light is positively injurious to plants; they absolutely require white light.' This scientist instituted the most elaborate experiments on the subject, ranging over eleven years, from 1850 to 1861; and the result of all his labor may be summed up in the simple statement that no illumination which human ingenuity can devise is so well adapted for promoting natural processes as the pure white light provided by the Creator. So much by way of general denial of the claims of superior efficacy residing in blue light of any kind.

"The spectroscope has clearly demonstrated that the violet glass acts purely as a shade for decreasing the intensity of the solar light. And in the simple fact that it does so serve as a shade lies the sole virtue (if any there be) of the glass. In 1856, Dr. Daubeny made experiments on the germination of seeds, and in his report is this suggestive sentence: 'In a south aspect, indeed, light which had passed through the ammonia sulphate of copper (blue solution), and even darkness itself, seemed more favorable than the whole of the spectrum; but this law did not seem to extend to the case of seeds placed in a northern aspect where the total amount of light was less considerable.'

"We now propose to finish our discussion by examining into the effects of light and darkness upon organisms. And we may especially here recall the fact that Gen. Pleasonton claims that not only does the blue light stimulate growth, but that it is a positive remedial agent for such severe ailments as spinal meningitis, nervous irritation and exhaustion, rheumatism, hemorrhage of the lungs, deafness, partial paralysis, shock due to severe contusion, and others, of all of which he cites cases.

"The theory that various colored lights exercise different effects on the human system is an old one. In 1831, Dr. Newbery of this city asserted that yellow light stimulates the nervous, pink the nutritive and blue the locomotive temperament; and recently Dr. Ponza, an Italian physician, has asserted that lunatics are greatly affected by being placed in different colored rooms. Red light, Dr. Ponza says, removes feelings of depression, blue induces calmness, and by violet light a crazy person was in one day cured.

"It is a thoroughly demonstrated fact that light is an important vital stimulant; and that, if its operation be excluded, the development of the healthy bodily structure is arrested. Naturalists tell us that in the absence of light the transformation of a tadpole into a frog is stopped, and the reptile remains a tadpole. Plants in darkness become blanched and stunted in growth; the process of fixing the carbon in their tissues is arrested, a modification of the coloring principle takes place, and they appear white instead of green. The sad effects of deprivation of sunlight are especially observable among those who live in crowded alleys or cellars, or who work in mines, where the light of the sun seldom or never penetrates. The total exclusion of the sun's beams produces an impoverished and disordered state of the blood, emaciation, muscular debility, and the diseases due to imperfect nutrition.

"On the other hand, it is known that for certain purposes darkness or shaded light is advantageous to the bodily condition. Fowls, for instance, may be fattened much more rapidly in the dark, and it would seem that the absence of light exercises a very great influence over the power possessed by food in increasing the size of animals. It likewise seems to exercise a soothing and quieting influence, increasing the disposition of animals to take rest, making less food necessary, and causing them to store up more nutriment in the form of fat and muscle. Now, if the organism to be treated is subjected to light, all of which is filtered through blue violet glass, then, as we have previously demonstrated, it is in light which is considerably shaded. And very probably to this cause—and not at all to the peculiar hue of the light—is to be attributed the quieting influence on nervous and insane people which Dr. Ponza has remarked.

"But Gen. Pleasonton does not use blue-violet glass alone. On the contrary, he employs a combination of blue light and pure sunlight, the latter very much preponderating. In his grapery, for example, only every eighth row of panes is blue. The mingled light consequently is merely pure sunlight, very slightly shaded, and the animal or plant exposed simply takes a sun bath—the *solarium* of the ancients, who, knowing the vivifying influence of the sunbeams, had terraces built on the tops of their houses so that they might bask in them. This sun treatment is now frequently recommended by physicians for nervous diseases. Dr. Hammond, in one of his lectures, says: 'In convalescence from almost all diseases, it acts, unless too intense or too long continued, as a most healthful stimulant, both to the nervous and physical systems. * * * The delirium and weakness, by no means seldom met with in convalescents kept in darkness, disappear like magic when the rays of the sun are allowed to enter the chamber.'

"It is hardly necessary to add that in our opinion the use of blue glass, as advocated by Gen. Pleasonton, is devoid of benefit."

To this Gen. Pleasonton replies in the New York *Evening Mail* as follows:

"*To the Editor of the Scientific American:*

"In your issue for February 24, 1877, you have inserted an article entitled 'The Blue Glass Deception,' which is devoted to the facts, and their explanation in part mentioned in my book, recently published, entitled 'Blue and Sun-lights, their Influence upon Life, Diseases, etc.'

"There is nothing in my character or history which justifies in any way the application of the term 'deception' to me, on any subject whatever—and this term is a reflection on the character and conduct of the Commissioner of Patents, who issued to me the letters patent for my discoveries of the attributes of the *associated* Blue and Sun-lights—as it is also on the character and conduct of the Commissioner of Patents of the Dominion of Canada, who has issued to me similar letters patent for the same discoveries. As for the facts described in my book, the Commissioner of Patents of the United States satisfied himself of the truth of my recital of them by sending an expert from his bureau to investigate, who, after having devoted three days to their examination at my farm, made a most favorable report of his investigations on the subject, without which the letters patent would not have been issued. Nothing, therefore, can be truthfully said against the facts as I have published them in my book. As for the explanations that I have given of the causes that have produced those facts, it may be proper to state that it was only after having discovered that the accepted theory of physics with which I was acquainted could furnish no satisfactory solution of the problem involved in my discoveries, that I devoted myself to an examination of the subjects, and I have evolved the only theories with which I am acquainted that will explain them.

"Your critic has fallen into the same error that characterizes an article in Crooke's London *Quarterly Journal of Science*, of October, 1876, in which, after quoting the experiments of Prof. H. Vogel, certainly no mean authority on the chemical action of light, who states in his Chemistry of Light and Photography (p. 78), that 'recent observations have established that yellow and red rays, and not the blue and violet rays, produce the greatest effects on the leaves of plants,' he states that Dr. R. Hunt, in that well-known work, the Poetry of Science, fully admits that 'seeds under blue glass will germinate long before others exposed to ordinary daylight, whilst under the yellow ray the process of germination is entirely checked,' thus contradicting Vogel. But he resumes, 'if the experiment is continued, it will be found that under the blue glass the plants grow rapidly but weakly, and that instead of producing leaves and wood, they consist chiefly of stalks upon which will be seen here and there some abortive attempts to form leaves. When the process of germination has terminated, if the young plant is brought under the yellow light, it grows most healthfully and forms an abundance of wood, the leaves having an unusually green color from the formation of a large quantity of chlorophyl. Plants do not, however, produce flowers with readiness under this medium,' (now, if they do not produce flowers, how can they produce fruit?) 'but if, at the proper period, they are brought under the red glass, the flowering and fruiting processes are most effectively completed.'

"Was there ever anything so absurd as this statement of differences in the attributes of primary rays of light? You must, according to these scientists, use three different processes to produce a vegetable! 1. Plant your seeds under blue glass till they germinate. 2. After the germination, transplant the young plant and put it under yellow light, to get some stalks, branches and leaves, but no blossoms; and, 3, transplant again, putting the plants under red light, and you will have beautiful vegetables! And these discoveries are called science, and the revealers of them philosophers.

"In confirmation Mr. Hunt quotes a letter from Mr. C. Lawson, of Edinburg, an eminent seed merchant. This gentleman, as early as 1853, had proved the value of blue light in accelerating the germination, and employed it practically in testing the value of the seeds coming into his hands in the course of business. He found that seeds could be thus caused to germinate in two to five days, instead of, as heretofore, in eight to fourteen days; but he adds that he 'has always found the violet ray prejudicial to the growth of the plant after germination.' Now, in my experiments with seeds and plants under the associated blue and sunlights, which were commenced in April, 1861, I have obtained results which show that the germination of the seeds, the development of the leaves, branches and stems, the formation of fruit buds, their flowering and the subsequent maturity of the fruit, were all produced by the action of these associated lights. In the sixteen years during which my experiments have been conducted, my grape vines have every year developed a growth of fifty feet in the season of growth, maturing their wood, forming their fruit-buds for the ensuing season, and have been more healthy and vigorous than any other vines of which I have any knowledge. Last summer, an unusually hot season, I have been informed by Mr. Dreer, a very intelligent dealer in plants, seeds, etc., in this city, who visited, with some of the Centennial Commissioners from foreign countries, the principal graperies in this neighborhood, that the foliage in all of them that were visited was greatly burned and dried by the heat, while in mine the leaves retained their freshness and green color till the beginning of November.

"Mr. Crooke says: 'Here, then, is a complete discrepancy, and either Gen. Pleasonton on the one hand, or Messrs. Vogel, Hunt and C. Lawson on the other, must be decidedly mistaken;' and with a manliness that is highly commendable in a scientist, he continues: 'One point of difference between Gen. Pleasonton's arrangements and those of the European experimenters upon the influence of the various rays of light upon organic life is that the latter, ourself included, submitted plants and animals to the sole and exclusive action of blue, yellow or red light respectively, whilst in Gen. Pleasonton's experiments, the blue light has been used mixed (i. e. associated) in certain proportions with ordinary daylight.' Mr. Crooke has thus found and appreciated the discovery. In Europe, they followed their own ideas, and failed. I followed, at an infinite distance, the plan of the Creator, who associates the blue light of the firmament with the sunlight in the season of growth to develop life on this planet. *Voita la difference.*

"Mr. Crooke proceeds: 'But if Gen. Pleasonton is in the right, the wonderful and salutary effects of blue light upon organic life are by no means the most extraordinary of its properties. Heat is also, in some *unaccountable* way, developed in the passage of sunlight through blue glass. * * It need scarcely be said that experimentalists have not found the blue and violet rays of the spectrum to be the hottest portions.'

"In quoting from my book, Mr. Crooke says: 'During the winter of 1871-2, which in this city (Philadelphia) was a very cold and rigorous winter, two ladies of my family, residing on the northern side of Spruce street, east of Broad street, in this city, who, at my suggestion, had caused blue glass to be placed in one of the windows of their dwelling, associated with plain glass, informed me that they had observed that when the sun shone through these associated glasses in the windows, the temperature of the room, though in midwinter, was so much increased that on many occasions they had been obliged, during sunlight, to dispense entirely with the fire which ordinarily they kept in their room, or if the fire was suffered to remain, they found it necessary to lower the upper sashes of their windows, which were without the blue glass, in order to moderate the oppressive heat.'

"Mr. Crooke concludes: 'We should feel much greater confidence in Gen. Pleasonton's observations if he had been content to place them before the world as novel, and if verified, important facts; but he goes much farther, and deduces from them an entire new philosophy. Into these, his doctrines, it will be early enough to examine when the action of blue light shall have been satisfactorily ascertained.'

"The moral of which is that it will never do to find out too many of nature's secrets at once, or to divulge them suddenly! Scientific nature can't stand it! Gently, General, or you overwhelm us!

"A writer has published in a Boston newspaper a notice of my book on 'Blue and Sunlights.' He is described as a scientist of great learning, practical experience and general intelligence. After slashing right and left, and condemning it *in extenso*, he explodes in denouncing it 'as a burlesque of science.' Though this expression is used in a sense intended to be derisive, I accept it, as Buffon, the naturalist, did, when Des Cartes ridiculed the famous story of the destruction of the Roman fleet in the harbor of Syracuse, by the burning mirrors of Archimedes, declaring it to be absurd and inconsistent with the science of Dioptrics, and yet Buffon repeated the experiment of Archimedes, so far as to set on fire combustibles at the distance of nine hundred feet with plane reflecting mirrors; or, as Cervantes, the celebrated author of the 'History of the renowned Don Quixote de la

Mancha,' did, when by it he destroyed chivalry and knighthood in Spain; or as Columbus did, when sailing in the Caribbean Sea, he discovered the islands off the coast of America, after having heard the gibes and jeers about his absurd schemes of a western route to the Indies; because my doctrines are destined to supersede all accepted theories, that cannot explain the phenomena that I have presented to the world.

"According to the experiments of Vogel, R. Hunt and C. Lawson, in order to get fruit or vegetables you must plant the seed under blue glass, to start them quickly, and when they have germinated there you must transplant the young plants under yellow glass, and, when their leaves are formed, you must again transplant them under red glass, and then you will insure a full development of the plant. How many crops would be raised by this process? And yet Vogel and Robert Hunt are among the most eminent scientists in Great Britain. Now I accomplish all these results by the association of blue and sun-lights, by passing through blue and plain glass.

"Now your criticism and that of Mr. Crooke in the first part of his article are based upon what you supposed to be the chemical action of light upon living organisms, which will not explain any of the phenomena that I have described, and hence actinism and the chemical theory must be abandoned. You will all have to adopt the electrical and magnetic theory that I have announced. You won't like it, but you will have to take it. It will be like going to school again to learn your alphabet.

"In conclusion, I may state that a gentleman of this city, Mr. Whitney, having some valuable plants which he wished to stimulate, *a la* Vogel and Hunt, directed his glazier to put yellow and green glasses in the windows of his house last fall, and in a short time he found them all dead, killed by those colors. He told me three days since that he had ordered these glasses to be removed and the blue glass to be substituted therefor. A French chemist has recently announced that the green and yellow colors are poisonous to and destructive of life.

"As you are a seeker after truth like myself, I would like you to explain why *the blue ray associated with white* light causes such wonderful results, and perhaps you may advance a theory more satisfactory than mine, and, if so, I will gladly adopt it."

THE ANALOGY OF SOUND AND LIGHT.

"The Saturday evening free lecture in connection with the Loan Collection of Scientific Apparatus at South Kensington was lately given by Professor Barrett, of the Royal College of Science, Dublin, on 'Some Experiments Illustrating the Analogy of Light and Sound.'

"The Professor commenced by referring to some of the well known facts about light and sound, such as that sound waves travel through air, while light waves travel through luminiferous ether, etc. Among many illustrations of the rate at which each travels, he gave this as a very intelligible one: If a canon were fired in London the sound would take about eight minutes to travel to Birmingham, a little over one hundred miles, while in the same time the light from the flash would have traveled to the sun, a distance of over ninety millions of miles. But, though they so differ in the rate of progress, both light and sound show many phenomena in common.

"In the experiments made during the evening the sensitive flame was used as a detector of sound. This delicate acoustic reagent, familiar to London audiences through Professor Tyndall's lectures, was first, we believe, discovered in 1866, by Professor Barrett, though he modestly did not allude to the fact. Indeed, most of the experiments shown during the evening formed the subject of a paper read by him before the Royal Dublin Society in January, 1868, and the discovery of the ratios referred to at the end of the lecture was announced in the *Quarterly Journal of Science* for 1870. The performance of the experiments, however, was entirely new to a London audience.

"The analysis of the phenomena of light and sound were illustrated in the following order: 1. Both light and sound get feebler as they leave their source of origin. In the case of sound this was shown with a loud ticking watch and a sensitive flame. 2. In reflection the angle of incidence is the same as the angle of reflection. In the case of sound, this was shown with the sound of a whistle sent along a tube, and reflecting along another placed at an angle to it from a reflector placed at the end where they approached. The distance to which a feble sound might be reflected perceptibly from a concave mirror was shown with mirrors over thirty feet apart. 3. With refraction, in the case of light, familiar convex lenses were used; and in the case of sound, analogous but less familiar lenses of gas of a different density from air were used. A collodion balloon, filled with carbonic acid gas, served as a double convex lens, and its action was manifested by the concentration of sound from the ticking watch on to the sensitive flame. 4. Both light and sound suffer absorption in passing through non-homogeneous media. Professor Tyndall's apparatus, showing the 'echoing back' of sound in passing through successive alternating layers of gas of different densities, is now well known, and every one is familiar with the fact that, though light may traverse a vessel of clear water, it can no longer travel when it is filled with bubbles of transparent air. 5. There is an analogy between the sympathy among the same notes of a gamut and the sympathy among individual colors in the spectrum. An incandescent body that produces a particular bright band in the rear of the spectrum will, when in a gaseous state, absorb light, and cause a dark band in exactly the same part of the scale. Tuning forks, wires, or columns of air in jars are responsive to vibrations produced by others exactly in unison, but only to those. This was shown in various ways in a very clear manner. 6. An analogy, which Professor Barrett called a more fanciful one, was spoken of. All the complex music of an orchestra is the result of a few simple notes variously combined. So all the tints of a picture are the results of a few simple colors variously combined. The musical scale sorts the complex notes in one case, the spectrum sorts the complex colors in the other. Professor Barrett, taking Professor Listing's determination of wave lengths, has made a most interesting comparison. The wave lengths of the notes of the gamut he expresses not in absolute but in relative measurement. Thus C is taken as 100, and all the other notes have their wave lengths expressed in percentages. Similarly, red is taken as 100, and the wave lengths of other colors are expressed in percentages. This interesting result comes out in comparing the two columns; D and orange are each 89; E and yellow 80; F and green, 75; G and the average of the blues, 67; A and violet, 60; B and ultra violet, 53; C and the obscure rays (black), 54. Further, the comparison of harmonies comes out in an interesting manner. Low C and upper C sound well together, so red and black go well together. Red and green, or C and F, harmonize well; but red and orange no lady would wear, and C and D make a combination by no means pleasant. Red and blue, or C and G, also go well together. 7. The concluding part of the lecture was devoted to an illustration of the figures described by vibrating bodies. Several apparatus for this purpose were briefly referred to, but especial attention was given to an apparatus of great ingenuity devised by Mr. S. F. Pichler. Professor Barrett showed it with an electric light and a reflection on to a screen. The principle of it may be thus described: Two metallic vibrators, each with a small speculum, are fixed at right angles to each other, and sounds are produced by a current of air acting on one or both of them at pleasure. The perpendicular vibrator is tuned to a given note; the horizontal vibrator is fitted with a mechanical arrangement whereby its pitch can be graduated to any degree of nicety within the compass of two octaves. An apparatus is also provided whereby a pencil of light is concentrated upon the speculum of the perpendicular vibrator, whence it is reflected to the speculum of the horizontal vibrator. For lecture purposes artificial light is used, which is further reflected and magnified upon a screen. When musical sounds are produced by the vibrators, various luminous geometrical figures are formed on the horizontal speculum and reflected on the screen by the single or joint action of the vibrators described by the pencil of light; and the form and motion of such figures demonstrate the exact relations to each other of the musical notes produced. Sounds which harmonize to the ear produce regular figures to the eye, as, for example, segments of the circle, ellipses, ovals, circles, or straight lines; and if the amplitude of each vibrator be equal, these luminous figures will hover on the speculum or screen with an apparent steadiness like that of the heavenly bodies hovering in the sky. If the sounds do not harmonize, the figures are confused, unsteady and complicated, presenting an appearance as if the wave lines were contending with each other. The mathematical relations of musical notes are also demonstrated, regular simple forms being produced by combination of those notes which result from vibrations bearing a definite numerical ratio to each other, while irregular and unsteady figures are caused by notes which have no such ratios. The pattern made on the screen by a discord is very bewildering to the eye.

"Professor Barrett, in concluding, said: 'After seeing how musical notes may be translated into moving lines of light, the words put by our poet into the mouth of Lorenzo have additional interest.

> "'There's not the smallest orb which thou behold'st
> But in his motion like an angel sings.'"

Major Festing conveyed the thanks of the audience to Professor Barrett.—*London Times.*

ASTRONOMY.

THE NEW SUN AND ITS DISAPPEARANCE.

The phenomenon of the appearance of a new star in the heavens is rare enough to arouse the greatest interest among astronomers and other scientific persons. It is not merely an occurrence appalling in its mystery and immensity; but even in the minds of those accustomed to contemplate the majesty of other worlds, it tends to arouse questions of the gravest importance relative to the physical and chemical constitutions of the stars, and to the comparison of our own sun with other far distant ones.

On November 24th last, M. Schmidt, Director of the Observatory at Athens, Greece, at 5h. 41m. in the evening, saw a star of the third magnitude in the constellation *Cygnus*. No record of the existence of any such star was in existence. No such star was visible on November 20th; but whether it appeared on one of the intervening days between that date and the 24th, M. Schmidt cannot say, as cloudy weather had then prevailed in Athens. The news was at once telegraphed throughout the world, and the astronomers watched the new star gradually wane until, on December 8th, it was scarcely of the sixth magnitude.

By comparing the observations of the discoverer, M. Schmidt, with those of M. Prosper Henry, we find two important facts: First, that within eight days the star diminished from the third to the fifth magnitude; and, secondly, that the color changed from a marked yellow to a bluish green. On December 2d, spectroscopic observations at different observatories were made; and the general conclusion was that the spectrum, being formed in large part of brilliant lines, was that of an incandescent vapor or gas. On December 4th, M. Cornu obtained a very satisfactory observation, which enabled him to identify three lines as the lines C, F and 434 of hydrogen.

A fourth appeared to him to correspond to the line, D, of sodium, and another with the characteristic line, *b*, of magnesium. Finally, two lines, of which the wave lengths are 531 and 451, appeared to coincide, one with the famous line 1474 (Kirchoff's scale), observed in the solar corona during eclipses; the other with a line of the chromosphere.

It thus appears that the light of this new star is exactly the same in composition as that of the solar chromosphere; and thus we are told that the new comer is a sun, doubtless in general respects like our own, which has met with some great catastrophe whose cause we cannot at present determine, but whose real nature is unmistakable.—*Scientific American.*

"Our sun," says Prof. Proctor, commenting on the phenomenon, "is one among hundreds of millions, each of which is probably, like it, the centre of a scheme of circling worlds. Each sun is rushing along through space, with its train of worlds, each bearing perhaps, like our earth, its living freight, or more probably each, at some time or other of its existence, becoming habitable for a longer or shorter period. Thus the suns may be compared to engines, each drawing along its well-freighted train. Accidents among these celestial engines seem fortunately to be rare. A few among the suns appear suddenly (that is in the course of a few hundred years, which in celestial chronometry amounts to a mere instant) to have lost a large part of their energy, as though the supply of fuel had somehow run short. Mishaps of that kind have not attracted much attention, though manifestly it would be a serious matter if our own sun were suddenly to lose three-fourths of his heat, as has happened with the middle star of the Plow, or ninety-nine hundredths, as has happened with the once blazing, but now scarcely visible, orb called *Eta* in the keel of the star-ship *Argo*. But when we hear of an accident of the contrary kind—a sun suddenly blazing out with more than a hundred times its usual splendor—a celestial engine whose energies have been over-wrought, so that a sudden explosion has taken place, and the fires, meant to work steadily for the train, have blazed forth to its destruction—we are impressed with the thought that this may possibly happen with our own sun. The circumstances are very curious, and though they do not show clearly whether we are or are not exposed to the same kind of danger which has overtaken the worlds circling around those remote suns, they are sufficiently suggestive.

"Now, a point to which I would call special attention, is that all the elements of the catastrophe, if one may so speak, which has befallen the remote sun in the Swan exists in our own sun. At times of marked disturbance parts of our sun's surface show the lines of hydrogen bright instead of dark, which means that the flames of hydrogen over those parts of the sun are hotter than the glowing surface of the sun there. We have all heard, again, how Tacchini and Secchi, in Italy, attributed some exceptionally hot weather we had a few years ago to outbursts of glowing magnesium. And, lastly, our sun is well supplied with that element, whatever it is, which gives the bright line of its corona during eclipses; for we now know that the whole of the streaked and radiated corona occupying a region twenty times greater than the globe of the sun (which itself exceeds our earth one million two hundred and fifty thousand times in volume) belongs to the sun. Again, though the sun has shone steadily for thousands of years, yet, so far as can be judged, the stars which, like this one in the Swan, have burst out suddenly, blossoming into flames of hydrogen, within which the star's heart core glows with many hundred times its former heat, have also been for ages shining steadily amid the star depths. We know that the one which blazed out ten years ago in the Northern Crown was one of Argelander's list, a star of the tenth magnitude, and that, after glowing with eight hundred times its former brightness for a few days, it has resumed that feebler lustre. We have every reason which analogy can furnish for believing that the new star, which was not in Argelander's list, simply escaped record by him on account of its faintness. It is now fast losing its suddenly acquired lustre, and is already invisible to the naked eye. It appears, therefore, that there is nothing in the long-continued steadfastness of our sun as a source of light to assure us that he, too, may not suddenly blaze forth with many hundred times his usual lustre (the conflagration being originated, perchance, by some comet unfortunately traveling too directly towards him). Though he would probably cool down again to his present condition in the course of a few weeks, no terrestrial observers would be alive at any rate to note the fact, though the whole series of events might afford subject of interesting speculation to the inhabitants of worlds circling round Sirius or Arcturus. Fortunately we may legitimately reason that the risk is small, seeing that among the millions of suns which surround ours, within easy telescope distance, such catastrophes occur only ten or twelve times per century."

In addition to the chances in our favor that our sun will not be the next one to blaze forth like that above described, Professor Loomis, of Yale College, explains that such variations in the brightness of stars are not very unusual nor very infrequent, and that while the cause of these phenomena, yet a matter of conjecture among astronomers, is probably the falling of some aerial wanderer, like a comet or a meteor, into the fixed star and its consequent rapid combustion, such an event need produce no serious results necessarily, since it is a commonly received theory that the continuous intense heat of the sun is caused by the constant accession of such combustible and inflammable bodies.

A COSMOSCOPE.

Last Monday evening Prof. C. B. Boyle exhibited before a few prominent members of the American Geographical Society a very ingenious instrument of his own invention, which shows the precession of the equinoxes, the portions of the globe which are illuminated by the sun at all seasons of the year, and, of course, in every point of its orbit. The instrument also shows the gradual variation of the inclination of the earth's axis to the ecliptic, and the circle which it would make in the heavens in the course of a grand cycle of time, 25,000 years. The following description of this philosophic application of the mechanical powers is from the inventor himself:

"The instrument was suggested by a conversation of Chief Justice Daly with the inventor upon the subject of the precession of the equinoxes, and though it was originally designed to render literal interpretation of the facts involved in that phase of our earth's relation to the sun, yet it presents with equal precision all the other facts of motion and their attendant phenomena. The sun is represented by a flame, situated a few inches above the centre of a round table upon which is figured a star chart, bounded by the twelve stars of the zodiac. The outer end of a slender arm extending from the centre is surrounded by a globe, upon which the light emitted by the flame is condensed by a lens. As this light steadily illuminates the hemisphere of the globe which is turned toward it, and as the axis about which the globe rotates is poised at the same angle of inclination to the plane of its orbit as that of the earth is to the plane of its orbit about the sun, it follows that precisely the same phases of illumination are presented upon both globes. The rising and setting of the sun, the changing lengths of day and night in different latitudes, the changes of the seasons, the long polar night and day, are all seen to occur in their proper order of succession. The eccentricity of the orbit with the sun in one of the foci of the ellipse, and the shifting of the direction of that eccentricity among the stars, is also presented. When the mimic moon is added, the eclipses of that body and of the sun present themselves, the shadow of the moon passing across the globe, first near the pole, and at each successive lunation lowers down until it passes off at the opposite pole, thenceforward the shadow of the moon passing into space clear of the globe until the combined mutations bring back the period of eclipses, thus presenting the facts successively as they occur in nature. An additional arm carries a comet so near the centre as to nearly graze the mimic sun at its perihelion, whence it departs to its aphelion distance in far off space, thence returning as before to the sun.

"At the instant the globe is passing its vernal equinox a bell is struck—a single blow, which, at each revolution of the globe about the centre, calls attention to that fact, so that the observer may see that the globe is in its equinox at the stroke of the bell, and note also that the equinox has slightly shifted its place upon the ecliptic—receded upon the star chart—gone backward in the sign of the zodiac in which it is then occurring, which slow shifting finally carries the equinoxes about the entire circle of the heavens, and, at the same time, changes the direction of the globe's axis of rotation, which returns to its original direction when the equinoxes return to their original position among the stars.—*New York Herald.*

SATURN'S DARK RING.

Mr. Trouvelot, of Cambridge, Mass., has noticed that the inner half of the dark ring is so transparent that the outline can hardly be recognized where it crosses the planet, whereas the outer half is so much more opaque that the outline of the planet can hardly be seen through it. This fact is not only remarkable in itself, but still more remarkable when we remember that until quite recently the character of the dark ring was quite different. The whole width of the ring was formerly uniformly transparent, or at least so nearly so that no difference could be recognized between the outer and inner parts of this ring. This thinning of the inner edge is probably accompanied by a gradual extension of the ring-system toward the planet.

Clerk Maxwell long since pointed out that a change of this sort was to be expected as a natural consequence of collisions taking place among the tiny moons forming this ring system. And other observations by Mr. Trouvelot shows clearly that multiplied collisions of this sort must continually occur; for he finds that from time to time the dark ring assumes an aspect showing that its substance is agglomerated in clustering masses, through which the light of the planet does not penetrate. How strange are the thoughts suggested by such changes! Within the ring itself what energy of life (so to speak) is indicated by the conflict of satellites! And as regards Saturn himself, does it not appear clear that, while such changes as these are taking place in the nearer portions of his system, he cannot yet be regarded as a completed world? We see nature's hand still at work out yonder, fashioning under the very eyes of astronomers the system of a planet once thought to have been formed even earlier than our earth.

The processes of cosmical development which were formerly so energetically disbelieved, but have now taken their place among astronomical probabilities (and almost as certainties), seem here to be actually in progress. Nature has been detected in the act, and there is good reason for believing now, what was suggested by the present writer eleven years since, that 'in the variations perceptibly proceeding in the Saturnian ring-system a key may one day be found to the law of development under which the solar system reached its present condition.—*London Spectator.*

From an examination of the observations of the minute star around which Sirius is revolving, Mr. Wilson, of Rugby, concludes that its period of revolution is two hundred years, in an orbit fifty times that of the earth. He also shows that while the sum of the masses of Sirius and its companion is about three times that of the sun, its light, according to the old method of calculation, is more than two hundred times that of the sun.

NATURAL HISTORY.

THE SEA SERPENT QUESTION REVIVED.

The recent accounts by the officers and crew of the steamship "Nestor" of an encounter with a sea serpent in the straits of Malacca, have revived the old discussions among scientific men regarding the possible existence of such an animal. Discarding the theory that the idea of the sea serpent originated in mythological ages and has been handed down from the Eddas and Sagas of the Norsemen, wherein the Midgard serpent, symbolizing really the sea itself, tumultuously encircling the whole earth in its coils, figures conspicuously, and that this sublime fancy has gradually passed from the profound northern mythology to the doubtful position of a modern superstition among credulous seamen, we will take up some later theories advanced in opposition to what appear to be the actual facts.

In the face of the most positive and seemingly indubitable testimony of experienced and careful nautical observers for hundreds of years past, the negative evidence that the researches of distinguished naturalists have failed to discover any physical traces of its existence in the past or present has been adopted by many scientific men as sufficient to warrant them in declaring the statements of alleged eye witnesses false, and it has therefore become the rule to deride all such stories as chimerical, sensational, or resulting from delusion of the witnesses.

In explaining away the statements made by sailors and others who claim to have observed sea serpents, it is customary to set forth that such objects as large pieces of sea weed floating with a head-like root projecting above the surface of the water, a shoal of porpoises tumbling along one after the other, a large horse mackerel or some other well known marine animal, have been mistaken for a serpent. In any ordinary tribunal the evidence of men accustomed to live upon the ocean and familiar with its appearances and that of all the more common animals, such as whales and porpoises, as well as that of such objects as sea weed, the low lying ranges of distant hills, etc., would be unhesitatingly received in preference to any such explanations as the above, while the theoretical impossibilities set forth by even such eminent scientists as Professor Owen would receive no consideration whatever. But as we are discussing the subject on scientific grounds, we will give in brief the points made by those who oppose Professor Owen's theories with their own.

Many fossil types of animals have been transmitted without interruption from remote geological periods to the present time; others have disappeared and reappeared at intervals more or less widely separated. As among the latter, it has been suggested that the sea serpent may represent, in a modified form, some one of the immense marine lizards of the secondary geological formations, such as the plesiosaurus, which disappeared in the tertiary age and may have reappeared now, in similar manner as did the chimæra *percopsis*, of Lake Superior, and the soft-shelled tortoise (*tryonychidæ*) of the same geological epoch. It is also argued that the absence of fossil or other remains is not to be regarded as very strong proof of the non-existence of sea serpents, since the remains of many animals which are much more frequently seen, such as seals and whales, are rarely found, which is a very natural circumstance considering the element in which they live and in the depths of which their dead bodies might readily be concealed forever. The conclusion of the best naturalists is that the existence of the sea serpent is possible, a verity which will yet come under scientific examination, and that it may prove to be some modified type of the secondary marine lizards. As the ichthyosaurus was replaced by the whale-like cetaceans, so the plesiosaurus may have been by the zeuglodont cetaceans, of which the sea serpent may prove to be a more or less modified form. This theory also finds some support in the fact that while all the so-called sea serpents are represented by their delineators as moving by vertical undulations, which is, from the structure of their vertebræ, impossible with serpents, the plesiosaurus, from its peculiar formation and vertebral structure, was enabled to perform this motion while swimming along, as well as in thrusting its head beneath the waves in searching for its food or raising it high above them in looking for aerial prey.

Some writers believe that the leviathan of the Scriptures is an analogue of the sea serpent, and quote Job as aptly describing a marine animal with formidable teeth, compactly fitted scales, invulnerable to the slings and spears of those days, fiercely flashing eyes, phosphorescent in appearance and carnivorous in its habits.

Ancient writers, as Palladius and Solinus, allude to a huge serpent, *Odontotyrannus*, which could swallow an elephant without masticating it. Pliny also describes a similar monster as inhabiting the waters of the Ganges.

Pontpoppidan, Bishop of Bergen, in his Natural History of Norway, 1752, states that if any one doubted the existence of the great sea serpent, along the coast of Norway, he was regarded by the natives as a jester, who might as well question the existence of the eel or any common reptile. He also illustrates his book with an engraving showing an immense reptile, whose length seems to be more than thrice that of the vessel, whose head is projected above the water to half the height of the mast, and from whose mouth volumes of water are being spouted. Large wing-like fins are attached to the breast of the monster, which is covered with compact scales from head to tail.

Capt. Laurent de Ferry, in 1746, saw one of these monsters, near the port of Malde, which he says was of a gray color, with brown mouth, black eyes, and a long mane floating about its neck. Its head resembled that of a horse, and its coils, which were very large, rose at intervals of six feet.

Mr. Maclean, a clergyman, described, in a communication to the Wernerian Society of Natural History, a monster which he saw in Juue, 1808, on the coast of Cali. It also moved by vertical undulations and was from seventy to eighty feet long. Some months later there was stranded upon one of the Orkney Islands the body of a monstrous serpent, which Dr. Barclay and other scientific men carefully examined and described. It was fifty-six feet long and ten feet in circumference, had a bristling mane extending nearly the whole length of its body, and was furnished with fins which measured about four feet and resembled the plucked wings of a goose.

Sea serpents have been seen by numerous witnesses along the coast of Massachusetts, near Gloucester, in 1815 and 1817; off Nahant, in 1819 and 1833, and further south, along the Atlantic Coast, in 1835 and 1848. The description of the last named, given by Capt. McQuhae, of Her Majesty's frigate Dedalus, was very minute, and was corroborated in most particulars by that of Lieut. Drummond, of the same vessel.

More recently a sea serpent was seen on the coast of Scotland, by Mr. James M. Jouass, a man of science and one not easily deceived or deluded. It was first seen by two ladies in September, 1873, again the next morning by Dr. Soutar, and the following day by Mr. Jouass himself. It is described in the *London Field* as being forty to fifty feet long, brownish yellow in color, and occasionally raising its head about four feet above the water.

In *Land and Water* for September 1, 1872, Frank Buckland gives a circumstantial account of a large serpent, about ninety-six feet long, black in color, with a flat head and probably a dorsal fin, which was seen by a visiting party, on two different occasions, in the waters of Loch Hourn, Scotland, in August, 1873. This monster also progressed by vertical undulations, which Mr. Buckland accounts for by suggesting that this may have been an immense ground-fish, with a motion in the vertical plane like the flat-fish, which occasionally comes to the surface.

The Panama *Star and Herald*, of February 16th, 1873, contains an account of a marine animal seen from the steamer Guayaquil, in the Bay of Panama. Its head was like that of a sea-horse, and its length was estimated at about twenty-five feet. A sting-ray fish, of large size, accompanied it at the time it was observed.

The description of the sea serpent observed by the officers of the steamship Nestor, referred to at the beginning of this article, is taken from the London *Spectator*, and is as follows:

"In the Straits of Malacca the sea-monster so repeatedly seen, and so repeatedly declared to be mythical, appears at last to have been carefully observed by competent witnesses. The creature was seen by the passengers and crew of the ship Nestor, on her voyage to Shanghai, and on her arrival at Shanghai the master of the ship (Mr. John Keller Webster) and the surgeon (Mr. James Anderson) made a statutory declaration of what they had seen, before a magistrate, as a mode, we suppose, of formally attesting that they spoke in good faith. The creature (which resembles a huge salamander, only instead of being about six or eight inches long, these dimensions must be multiplied by at least seventy-five or one hundred, the body being from forty-five to fifty feet in length, the head twelve feet, and the tail, it is said, no less than 150 feet), was first seen at 10:30 on the 11th of September, fifteen miles northwest of the North Sand Lighthouse, in the Straits of Malacca. The weather was fine, the sea smooth, and the air perfectly clear. The Chinese on deck were terribly alarmed and set up a howl. The whole watch and three saloon passengers saw the creature clearly and observed its movements. It traveled for a long time about as fast as the steamer, appearing to paddle itself by the help of 'an undulatory motion of its tail in a vertical plane.' The body and tail were marked as those of the salamander are marked—with alternate bands, black and pale yellow in color. 'The head was immediately connected with the body, without any indication of a neck.' Both witnesses state positively that the only resemblance was to some creature of the frog or newt kind, while one of them (the surgeon) says the longer he observed it the more he was struck with its resemblance to a gigantic salamander. Its back was oval in form. No eyes or fins were seen, and it did not blow or spout in the manner of a whale. The greater part of its head was never seen, being beneath the surface."

The New York *Graphic* publishes a very remarkable letter, dated Honolulu, January 8, 1877, giving an account of an attack upon the brig Albatross, November 10, 1876, by an immense serpent, in latitude 21° 11′ south and longitude 122° 25′ west. When first seen, the animal was about one mile and a half to windward and making direct for the brig. The captain ordered the guns loaded and the brig kept off a little. But the serpent continued to approach rapidly and at last reached the vessel. Raising his head he struck at the windlass, without doing any harm, He was fired upon and wounded, upon which the creature withdrew and disappeared. The captain of the Albatross describes this animal as being three feet thick at the neck and about four and a half to five feet at the shoulders, with large scales all over the body, immense mouth with teeth in both jaws, the top of the head rounded up high and the neck puffed out like an East India cobra's. To make the story complete, the captain states that on the 12th November the French bark Esperance came across a dead serpent floating in the water, not far from the locality described above, which measured about 45 metres in length by two metres diameter in the largest part; was covered with large scales; had no fins, but had a broad tail like a shark.

While many of the sea serpent stories may be classed as "fishy," enough testimony of a positive and indisputable kind has been furnished to render it at least probable that a few marine monsters still inhabit the sea whose size warrants navigators in pronouncing them sea serpents. One of our most esteemed contemporary periodicals contains an article on this subject, in which the following language is used:

"And the idea of fraud in such matters is not nearly so reasonable as many seem to imagine. Travelers are sometimes said to tell marvelous stories; but it is a noteworthy fact that in nine cases out of ten the marvelous stories of travelers have been confirmed. Men ridiculed the tale brought back by those who had sailed far to the south, that the sun there moves from right to left, instead of from left to right, as you face his mid-day place; but we know that those travelers told the truth. The first account of the giraffe was laughed to scorn, and it was satisfactorily proved that no such creature could possibly exist. The gorilla would have been jeered out of existence but for the fortunate arrival of a skeleton of his at an early stage of our acquaintance with that prepossessing cousin of ours. Monstrous cuttle-fish were thought to be monstrous lies till the Alecton, in 1861, came upon one and captured its tail, whose weight of forty pounds led naturalists to estimate the entire weight of the creature at four thousand pounds, or nearly a couple of tons. In 1873, again, two fishermen encountered a gigantic cuttle in Conception Bay, Newfoundland, whose arms were about thirty-five feet in length (the fishermen cut off from one arm a piece twenty-five feet long), while its body was estimated at sixty feet in length and five feet in diameter—so that the devil-fish of Victor Hugo's famous story was a mere baby cuttle by comparison with the Newfoundland monster. The mermaid, again, has been satisfactorily identified with the manatee, or 'woman-fish,' as the Portuguese call it, which assumes, says Captain Scoresby, 'such positions that the human appearance is very closely imitated.'

"As for stories of sea serpents, naturalists have been far less disposed to be incredulous than the general public. Dr. Andrew Wilson, for instance, after speaking of the recorded observations in much such terms as I have used above says: 'We may, then, affirm safely that there are many verified pieces of evidence on record of strange marine forms having been met with, which evidence, judged according to ordinary and common sense rules, go to prove that certain hitherto undescribed marine organisms do certainly exist in the sea depths.' As to the support which natural history can give to the above proposition, 'zoologists can but admit,' he proceeds, 'the correctness of the observation. Certain organisms, and especially those of the marine kind (*e. g.*, certain whales), are known to be of exceedingly rare occurrence. Our knowledge of marine reptilia is confessedly very small; and, best of all, there is no counter-objection or feasible argument which the naturalist can offer by way of denying the above proposition. He would be forced to admit the existence of purely marine genera of snakes which possess compressed tails, adapted for swimming, and other points of organization admittedly suited for a purely equatic existence. If, therefore, we admit the possibility—nay, even the reasonable probability—that gigantic members of these water snakes may occasionally be developed, we should state a powerful case for the assumed and probable existence of a natural sea serpent. We confess we do not well see how such a chain of probabilities can be readily set aside, supported as they are in the possibility of their occurrence by zoological science, and in the actual details of the case by evidence as trustworthy in many cases as that received in our courts of law.'

"When we remember how few fish or other inhabitants of the sea are ever seen compared with the countless millions which exist, that not one specimen of some tribes will be seen for many years in succession, and that some tribes are only known to exist because a single specimen or even a single skeleton has been obtained, we may well believe that in the sea, as in heaven and earth, there are more things 'than are known in our philosophy.'"

A LECTURE ON ANTS.

Sir John Lubbock lectured recently at the Royal Institution, London, on the subject of ants, to a crowded and interested audience. Briefly describing the different species, which in this country amount to some thirty, and in warmer parts of the globe to over seven hundred, the gentleman said that he had under observation thirty nests of over twenty species, no two of which were identical in habits. Most of their time is passed underground, and being essentially gregarious, it was difficult to keep them alive by themselves, at any rate without entirely altering their habits. Though much attention had been paid to their habits by distinguished naturalists, so little was at present known that the study offered a most promising field for observation and experiment. Describing the small white legless grubs constituting the larvæ of ants, and the care with which they are tended, sorted out into sizes, and carried from chamber to chamber by the workers to secure the most suitable amount of warmth and moisture, and the different sizes into which they develop to produce the queens, the males, and the workers, a differentition which is carried still further in tropical countries, he said their food consisted of small insects, honey, honey-dew, and, indeed, almost any animal of sweet vegetable substance. The small garden ant ascends bushes to seek out the aphides which infest their leaves. These insects are gently tapped with the antennæ of the ants, and then give out a drop of sweet fluid, which is at once appropriated as food by the ants. Another species of ant seeks out the aphides which infest the roots of grass, collect them, and keep them throughout the winter for the spring, an instance of forethought which needed more prudence than many savages or even many civilized persons display. Many insects lived as guests with the ants, notably beetles, which were tended and carried about like their own larvæ, probably because the beetles, like the aphides, emitted some sweet fluid that was edible by the ants. Even ants are subject to parasites, and Sir John described one of his own specimens that since the 14th of October has had a sort of mite adhering to the under side of her head. Different species of ants differ as much in their characteristics as the different races of mankind. Some were gentle and submissive, and were made slaves of by those who were more audacious. Some are cowardly, and fly from the approach of danger, while other species are so courageous that a single specimen surrounded by enemies never attempts to fly, but fights valiantly until overpowered by numbers. Ants have long had the credit of being industrious, and with good reason, for Sir John describes, as the result of close observation, one of the workers in his own collection as being actively employed without intermission from six in the morning till 10:15 in the evening. The length of the preparatory stages of life was pretty well known, but the total duration of ant existence has yet to be determined. Sir John has workers still healthy and active which were captured in September and November, 1875, and queens which he has had under observation since December, 1874. As a rule each species lives by itself, but there are exceptions, and one species is found exclusively in the nests of largor varieties, but at present the relationship between them is not understood. One species is so dependent on slaves for the care of their young, and even for being fed, that without their slaves they cannot exist, though in the presence of ample supplies of the best food. In two of his nests Sir John found that two ants from each were deputed to come out and fetch food for the rest of the community, consisting in one case of about two hundred, and in the other of four hundred individuals. When these messengers were captured and imprisoned, two fresh messengers were appointed from each nest, the experiment being repeated several times, always with the like result. Experiments to test the intelligence of ants were not favorable to their capacity in that respect, for when cut off from their food supply by drawing back a little strip of paper which acted as a bridge, they had not intelligence to rebridge the chasm of one-third of an inch by pushing the strip of paper back. Varied experiments of a similar character resulted in the same way, except where a hole leading into a box containing food was stopped by a little mold; then the ants speedily burrowed into the mold, and found their way into the box, and again carried off the food. Sir John did not find that display of intelligence and affection which some naturalists had declared induce ants, when any of their companions are accidentally buried, to burrow down and rescue them. They do seem capable of discriminating between companions and strangers, for when a number of each were intoxicated and placed near a nest, the sober ants, after being very much puzzled at the unaccountable condition of the inebriates, carefully carried into the nest their helpless friends and pitched the strangers into a dish of water. When, however, some friends and strangers were chloroformed to death and laid near a nest the ants seemed to appreciate that the deceased were past remedy, and therefore pitched both friends and strangers indiscriminately over the edge of the table. Attempting to verify the truth of Huber's declaration that when ants had been separated for four months and then returned to their nest they were recognized and carressed by their companions, Sir John found that though there was no sign of recognition when a separated friend was returned to the nest, he was never attacked, while a stranger being put in was always driven out or even killed. As regards the senses of ants, though Sir John believes they hear, yet they take no notice of any sound he could make, and though they undoubtedly see, they cannot have very keen sight. His experiments do not confirm the suggestion that ants are able to communicate to their companions where food has been discovered, for when single ants had been placed on food, and, going back with some to the nest, were returning with companions to the store, in every case where these pioneer ants were captured their companions wandered about helpless, and failed to find their way to the spot. Many other anecdotes of his experiments were recounted by the honorable baronet, who concluded by an interesting account of the provisions in the vegetable kingdom for preserving the pollen of flowers from the assaults of ants.

THE NIGHT-STINGING SPIDER.

"During the recent spell of warm spring weather, a well known entomologist, Mr. C. J. Bethune, M. A., discovered in Central Park, near the 7th regiment memorial monument, a pair of remarkable looking spiders. He watched them for some time, and found that they inhabited an underground mansion; that, in fact, they were burrowers. Provided, as enthusiastic entomologists invariably are, with a tin case for the reception of specimens, the two active spiders were transferred with some little difficulty to confinement, together with a portion of the sandy soil in which they had evidently passed the winter. Mr. Bethune has since been studying his prisoners, and he has now no doubt whatever about their identity. When in New Zealand he had seen a spider seemingly identical with his specimens; but the insect in question, so far as he knew, was peculiar to New Zealand, and had seldom or never been seen even in Australia. 'As I watched the pair of little wretches,' said Mr. Bethune to the writer, 'I knew I could soon test the question of their suspected identity with the New Zealanders. I had but to present my finger, but I was unwilling to incur the probable consequences of the experiment. I had a Spitz dog. I took the larger spider in a delicate wire tweezer, and I applied it to the inside of the dog's ear. The insect was nowise loath. The dog howled in agony, its head began to swell, its mouth to froth, until death relieved it in five hours. I had resolved to destroy the dog anyhow. The spider thus became the executioner of the canine and identified itself. Unquestionably the spider is the New Zealand terror. The Latrodectus katipo, or night-stinging spider, is the most dangerous creature in that distant island, and the dread of European immigrants and Maoris alike.'

"Till within late years comparatively little was known of the katipo, except on the hearsay evidence of the aborigines, whose hair-raising stories of the deadly effects of its bite excited great and natural alarm. The native name, katipo, signifies 'night-stinger'—being derived from two words, kakati, to sting, and po, the night. The range of this spider has always been regarded as somewhat local, and in the island has been thought to be confined to the seashore. Dr. Buller, of Wellington, in a recent article on the subject, states that there is a small extent of sand hills near Woiksnae, on the west coast, noted among the natives for the abundance of katipo· 'A settler residing there, named Jenkins, assured me that he could, without difficulty, fill a quart measure in a few hours. In 1867, I collected in the same locality a considerable number, and kept them alive for several weeks in order to study their habits. And here I may mention a circumstance illustrative of the wonderful tenacity of life possessed by this formidable member of the Arachnida family. I shut up a full grown katipo in a druggist's chip-box on May 11, and placing it among other objects in my cabinet, it was overlooked and forgotten. I consequently did not open the chip-box again until October 8, following, when I found the spider alive and active, and apparently none the worse for a five months' fasting! I am inclined to consider the above case corroborative of the native account that on the approach of cold weather the katipo retires to a cell underground and passes the winter in a torpid state, and that in this condition it may be handled with perfect impunity.'

"It seems idle to speculate how these venomous insects reached this country. We know that ships from New Zealand are continually reaching our shores, and that during the early months of the Centennial year this communication was exceptionally large. It is more than likely, however, that the Latrodectus katipo has been colonized among us for some years. A single pair produces an incredible offspring in a single season; and our sandy soil and seashores, like Coney Island, may soon be rendered more dangerous than an Indian jungle or a Florida swamp by this deadly and industrious insect."—*New York Mercury.*

SCIENTIFIC MISCELLANY.

SCIENCE AND RELIGION.

It is generally supposed by the average thinker that all religious persons regard the doctrines of Darwin and Huxley as at least akin to atheism, if not atheism itself, and it may surprise some of our readers to learn that many wise and good Christians accept the development theory as probably correct and demonstrable, and one which may be believed in without any decrease or modification of their faith in God and Christianity. Others again seem to regard every new theory or discovery in science as an attack aimed at religion, and feel themselves called upon to rush impetuously to its defense, whether properly and sufficiently armed to render effective service or not.

For the benefit and information of this latter class, which was greatly agitated by the announcement that Prof. Huxley was about to deliver a series of lectures upon evolution, in New York, during the past winter, the *Independent* offered a few suggestions, showing as nearly as possible the exact position of scientific Christians upon this subject. The points made were as follows:

"1. Evolution and Darwinism in its strict sense are not the same thing. Darwinism is one theory of evolution, that of Charles Darwin. According to it each living organism has in it capacity of producing its like within a narrow range of very slight, almost inappreciable variation in any and every part and direction. This is but an evident and patent fact. It also holds that the surroundings of every living creature, its environment, kill off early those which are less adapted to fight their own way, leaving those which have varied favorably to produce offspring like themselves with further minute variations. Darwinism holds that this is sufficient to account for all the origination of species. But there are other theories of development. There are scholars who hold that like does not always produce like, and who point to well-known instances in which variation has proceeded by a leap, and in which some marked variety, if not species, has been known suddenly to rise. In this they see no law, but think they recognize the guidance of some superior power. This we give as one example of a development theory which is not Darwinism; there are others. In the view of those who hold them, Darwinism errs not in its two principles, but in its assumption that these are all the laws of variation. Even Darwin affords the storehouse out of which the facts for other theories are gathered, and in his later works recognizes other laws of variation.

"2. Let it not be forgotten that many wise and reverent Christians either warmly advocate or willingly accept development. At the present day nearly all students of the laws of life are Darwinists in the broader sense of the word. They are believers in the origination of species by birth and development, and not by special creation. Of these a fair proportion, as large a proportion as of lawyers or of statesmen, believe in God and in Christianity. They are an exceptionally intelligent body of men, thinkers by careful training, and they believe that one can accept heartily the cardinal truths of our faith, and yet hold that man and all animals and plants are developed from primordial vital germs. Some respect should be paid to such men. They deserve it. They may be wrong in holding both to development and religion, but the presumption is that they are not. Their position is re-enforced by not a few of our most intelligent theologians, of whom President McCosh may be taken as a type, who are equally emphatic in holding that the two positions may be consistently held.

"3. Let it not be forgotten that in this matter the theologians are at a disadvantage. They do not have the final word in this matter of development. The belief of the world is to be settled utterly without their advice. Not what they say, but what the scientists say, is to conclude this debate. Whether species have been produced by development or by creation is a question of fact, to be settled purely by scientific evidence. It is not a matter of philosophy or of morals, to be decided by consulting the psychical or ethical consciousness; nor is it a matter of revelation, to be decided by consulting the Word of God. For the conclusions we must examine to see whether new species are being now produced about us, and whether the records which the earth has preserved of its own history tell us anything on this subject. This is the task of the naturalist, and not of the religionist; and, so far as we can judge at present, the answer which the naturalist will give is in favor of the new theory. Not many years ago the answer would have been just the contrary. Geologists were catastrophists, and thought they had evidence that sudden changes had occurred in the condition of the earth, and that one thousand utterly new creatures had more than once been simultaneously introduced. Then geology was the record of miracles one hundred times more stupendous than any recorded in the Gospels; but now the tide has turned, and another view is generally taken. There will be a sifting of evidence and a settlement of judgment, which will be final, and which theologians will have to accept. At present, we say, it looks extremely probable that the result will be the victory of evolution. Now, with this probability, or even with a possibility of it, it is not generalship for those who set themselves up as the special defenders of revelation to make it absolutely inconsistent with evolution.

"4. Evolution does not deny God. Nearly all evolutionists are theists. We acknowledge that it appears to remove God a little further off, but that is only in seeming. God may be just as active and present in law as he is in miracle. Be it remembered that every single conquest which science has made in reducing phenomena under the sway of law has appeared to many to put God at a greater distance. But by it God's government has only been made more orderly, and his own character more glorious.

"5. Let it be remembered that many wise men hold with Prof. Asa Gray that the argument for the existence of God drawn from design is not destroyed or even weakened by the theory of evolution. They see a designer in the law and progress of the evolution of an eye or a hand as clearly as in its absolute creation. Now allow us a God, and revelation is an easy deduction. That evolution is inconsistent with the literal prosaic interpretation of the story of Adam created *de novo* out of dust, and Eve out of his rib, we do not deny; but the story of Eden is so true in its essence, and yet carries so many signs of a symbolic or poetical meaning that this fact need disturb none but those who will not listen to reason. It is even true that the story of the fall of man in its most literal interpretation, with the doctrine of imputation of Adam's sin included, is not utterly inconsistent with development, though it is with Darwinism. None but the most rigid defenders of an unchangeable faith, settled to its minutiæ some centuries ago, need fear the doctrine.

"We offer these thoughts by way of caution. Not that we believe that religionists need warning more than scientists, but because we speak to the former rather than to the latter."

There are men who, like Rev. John H. Hopkins in his lecture on the "True relations between Science and Religion," take the ground that nothing is more untrue or unfortunate than the idea that these two things are antagonistic. The theologian expounds the revealed Word of God, the scientific man is simply an interpreter of his wonderful works for our information, and in many respects a teacher of the theologian. As a rule, scientific men are candid, fair-minded seekers after truth, and give to the world merely the results of their researches and what they believe to be the necessary and logical outgrowth therefrom, building up their theories on the basis of the "coincidence of observed facts with theoretical requirements," and remorselessly abandoning them when convinced of their insufficiency or untenability.

The pursuit of scientific subjects stimulates thought, and even when scientists fail of finding what they are immediately in search of they frequently make other discoveries which are of vast benefit to mankind, and give us a more exalted conception of the Deity. Science and religion are inseparable and even essential one to the other. No man need fear that the truth will be obscured by the revelations of science, even should all the scientists of the world combine to accomplish this object. "The truth cannot conflict with God's Word however much it may conflict with man's interpretation of it."

Having indicated above some of the admitted points of agreement between advanced and learned religionists and the advocates of the evolution theory, we quote from Huxley's lecture upon "The Demonstrative Evidence of Evolution," some of the more interesting features of his demonstration of the gradual successive changes in animal structure during past ages:

"The proof of evolution cannot be complete until we have obtained demonstrative evidence, and that evidence has of late years been forthcoming in considerable and continually increasing quantity. Indeed, it is somewhat surprising how large is the quantity of that evidence, and how satisfactory is its nature, if we consider that our obtaining such evidence depends upon the occurrence in a particular locality of an undisturbed series deposited through a long period of time, which requires the further condittion that each of these deposits should be such that the animal remains imbedded in them are not much disturbed, and are imbedded in a state of great preservation. Evidence of this kind, as I have said, has of late years been accumulating largely, and in respect to many divisions of the animal kingdom. But I will select for my present purpose only one particular case, which is more adapted to the object I have in view, as it relates to the origin, to what we may call the pedigree, of one of our most familiar domestic animals—the horse. But I may say that in speaking of the origin of the horse I shall use that term in a general sense as equivalent to the technical term *Equus*, and meaning not what you ordinarily understand as such, but also asses and their modifications, zebras, etc.

"Without attempting to take you very far into the region of osteological detail, I must nevertheless—for this question depends upon the comparison of such details—trouble you with some points respecting the anatomical structure of the horse, and more especially with those which refer to the structure of its fore and hind limbs. But I shall only touch upon those points which are absolutely essential to the inquiry that we have at present put. Here is the fore-leg of a horse. The bone which is cut across at this point is that which answers to the upper-arm bone in my arm, what you would call the humerus. This bone corresponds with my fore-arm. What we commonly term the knee of the horse is the wrist; it answers to the wrist in man. This part of the horse's leg answers to one of the human fingers, and the hoof which covers this extended joint answers to one of my nails.

"You observe that, to all appearance, there is only one bone in the fore-arm. Nevertheless, at the upper end I can trace two separate portions; this part of the limb, and the one I am now touching. But as I go farther down it runs at the back part into the general bone, and I cease to be able to trace it beyond a certain point. This large bone is what is termed the radius, and answers to the bone I am touching in my arm, and this other portion of bone corresponds to what is called the ulna. To all appearance in the forearm of the horse the ulna is rudimentary, and seems to be fused into one bone with the radius.

"It looks thus as if the ulna, running off below, came to an end, and it very often happens in works on the anatomy of the horse that you find these facts are referred to, and a horse is said to have an imperfect ulna. But a careful examination shows you that the lower extremity of the ulna is not wanting in the horse. If you examine a very young horse's limb you will find that this portion of the bone I am now showing you is separable from the rest, and only unites as the animal becomes older, and this is, in point of fact, the lower extremity of the ulna; so that we may say that in the horse the middle part of the ulna becomes rudimentary and unites with the radius, and that the lower extremity of the ulna is so early united with the lower extremity of the radius that every distinct trace of separation hasv anished in the adult.

"I need not trouble you with the structure of this portion that answers to the wrist, nor with a more full description of the singular peculiarities of the part, because we can do without them for the present, but I will go on to a consideration of the remarkable series of bones which terminates the fore-limb. We have one continuous series in the middle line which terminates in the coffin-bone of the horse upon which the weight of the fore-part of the body is supported. This series answers to a finger of my hand,

and there are good reasons—perfectly valid and convincing reasons, which I need not stay to trouble you with—which prove that this answers to the third finger of my hand enormously enlarged.

"And it looks at first as if there were only this one finger in the horse's foot. But, if I turn the skeleton round, I find on each side a bone shaped like a splint, broad at the upper and narrow at the lower end, one on each side. And those bones are obviously and plainly and can be readily shown to be the rudiments of the bones which I am now touching in my own hand —the metacarpal bones of the second and of the fourth finger—so that we may say that in the horse's fore-limb the radius and ulna are fused together, that the middle part of the ulna is excessively narrow, and that the foot is reduced to the single middle finger, with rudiments of the two other fingers, one on each side of it. Those facts are represented in the diagram I now show you of the recent horse. Here is the fore-limb (pointing to the diagram), with the metacarpal bones and the little splint-bones, one on each side. It sometimes happens that by way of a monstrosity you may have an existing horse with one or other of these toes—that is provided with its terminal joints.

"Let me now point out to you what are the characteristics of the hind-limb. This (pointing to the diagram) is the shin-bone of the horse, and it appears at first to constitute the whole of the leg. But there is a little splint at this point which is the rudiment of the small bone of the leg—what is called the fibula—and then there is connected with the lower end of the tibia a little nodule which represents the lower end of the fibula, in just the same way as that little nodule in the fore-limb represents the lower end of the ulna. So that in the leg we have a modification of the same character as that which exists in the fore-limb—the suppression of the greater part of the small bone of the leg and the union of its lower end with the tibia. So, again, we find the same thing if we turn to the remainder of the leg. This (showing) is the heel of the horse, and here is the great median toe, answering to the third toe in our own foot; and here we have upon each side two little splint bones, just as in the fore-limb, which represent the rudiments of the second and the fourth toes—rudiments, that is to say, of the metatarsal bones, the remaining bones having altogether vanished. Let me beg your attention to these peculiarities, because I shall have to refer to them by-and-by. The result of this modification is, that the fore and hind limbs are converted into long, solid, springy, elastic levers, which are the great instruments of locomotion of the horse.

"I think that will suffice as a brief indication of some of the most important peculiarities and characteristics of the horse. If the hypothesis of evolution is true, what ought to happen when we investigate the history of this animal? We know that the mammalian type, as a whole—that mammalian animals—are characterized by the possession of a perfectly distinct radius and ulna, two separate and distinct movable bones. We know, further, that mammals in general possess five toes, often unequal, but still as completely developed as the five digits of my hand. We know, further, that the general type ot mammal possesses in the leg, not only a complete tibia, but a complete fibula—a complete, distinct, separable bone. Moreover, in the hind-foot we find, in animals in general, five distinct toes, just as we do in the fore-foot. Hence it follows a differentiated animal like the horse, must have proceeded by way of evolution or gradual modification from a form possessing all the characteristics we find in mammals in general. If that be true, it follows that if there be anywhere preserved in the series of rocks a complete history of the horse, that is to say of the various stages through which he has passed, those stages ought gradually to lead us back to some sort of animal which possessed a radius and an ulna, and distinct complete tibia and fibula, and in which there were five toes upon the fore-limb, no less than upon the hind-limb. Let us turn to the facts and see how they bear upon the requirements of this doctrine of evolution.

"In the earlier Pliocene and later Miocene epoch, in deposits which belong to that age, and which occur in Germany and in Greece, in India, in Britain and in France, we find animals which are like horses in all the essential particulars which I have just described, and the general character of which is so entirely like that of the horse that you may follow descriptions given in works upon the anatomy of the horse upon the skeletons ot these animals. But they differ in some important particulars. There is a difference in the structure of the fore and hind limb, and that difference consists in this, that the bones which are here represented by two splints, imperfect below, are as long as the middle metacarpal bone, and that attached to the extremity of each is a small toe with its three joints of the same general character as the middle toe, only very much smaller, and so disposed that they could have had but very little functional importance, and that they must have been rather of the nature of the dew-claws such as are to be found in many ruminant animals. This *Hipparion*, or European three-toed horse, in fact presents a foot similar to that which you see here represented, except that in the European *Hipparion* these smaller fingers are farther back, and these lateral toes are of smaller prorortional size.

"Now let us go a step farther back to the middle and older parts of which are called the Miocene formation. There you find in some parts of Europe the equine animals which differ essentially from the modern horse, though they resemble the horse in the broad features of their organization. They differ in the characters of their fore and hind limbs, and present important features of differnce in the teeth. The forms to which I now refer are what constitute the genus *Anchitherium*. We have three complete toes; the middle toe is smaller in proportion, the inner and outer toes are larger, and in fact large enough to rest upon the ground, and to have functional importance—not an animal with dew-claws, but an animal with three functional toes. And in the fore-arm you find the ulna a very distinct bone, quite readily distinguishable in its whole length from the radius, but still pretty closely united with it. In the hind-limb you also meet with three functional toes. The structure of the hind-foot corresponds with that of the fore-foot; but in the hind-leg the fibula is better developed. In some cases I have reason to think that it is complete; at any rate this lower end of it is quite distinctly recognizable. In this succession of forms you have exactly that which the hypothesis of evolution demands. The history corresponds exactly with that which you would construct *a priori* from the principles of evolution. An alternative hypothesis is hardly conceivable, but the only one that could be framed would be this, that the *Anchitherium*, the *Hipparion*, and the horse, had been created separately and at separate epochs of time.

"Of late years there have been discovered on this continent—in your Western Territories—that marvelous thickness of tertiary deposits to which I referred the other evening, which gives us a thickness and a consecutive order of older tertiary rocks admirably calculated for the preservation of organic remains, such as we had hitherto no conception of in Europe. They have yielded fossils in a state of preservation and in number perfectly unexampled. And with respect to the horse, the researches of Leidy and others have shown that numerous forms of that type are to be found among these remains. But it is only recently that the very admirably contrived and most thoroughly and patiently worked-out investigations of Prof. Marsh have given us a just idea of the enormous wealth and scientific importance of these deposits. I have had the advantage of glancing over his collections at New Haven, and I can truly and emphatically say that, so far as my knowledge extends, there is nothing in any way comparable, for extent, or for the care with which the remains have been got together, or for their scientific importance, to the series of fossils which he has brought together. (Applause.) This enormous collection has yielded evidence of the most striking character in regard to this question of the pedigree of the horse. Indeed, the evidence which Prof. Marsh has collected tends to show that you have in America the true original seat of the equine type—the country in which the evidence of the primitive form and successive modifications of the horse series is far better preserved than in Europe. The succession of forms which he has brought together shows, in the first place, the great care and patience to which I have referred. Secondly, there is this Pliocene form of the horse (*Pliohippus*); the conformation of its limbs presents some very slight deviations from the ordinary horse, and with shorter crown of the grinding teeth. Then comes the form which represents the European *Hipparion*, which is the *Protohippus*, having three toes and the forearm and leg and teeth to which I have referred, and which is more valuable than the European *Hipparion* for this reason: it is devoid of some of the peculiarities of that form—peculiarities which tend to show that the European *Hipparion* is rather a side branch than one in the direct line of succession. Next comes the *Miohippus*, which corresponds pretty nearly with what I spoke of as the *Anchitherium* of Europe, but which has some interesting peculiarities. It presents three toes—one large median and two lateral ones; of the toe which answers to the little finger of the human hand, there is only a rudiment. This is, however, as far as European deposits have been enabled to carry us with any degree of certainty in the history of the horse. In the American tertiaries, on the contrary, the series of equine forms is continued down to the bottom of the Eocene. The older Miocene form, termed *Mesohippus*, has three toes in front and a large splint-like rudiment representing the little finger, and three toes behind. The radius and ulna are entire, and the tibia and fibula distinct, and the teeth are anchitheroid with short crowns.

"But the most important discovery of all is the *Orohippus*—which comes from the lower part of the Eocene formation, and is the oldest member of the equine series known. Here we have four complete toes on the front-limb, three toes on the hind-limb, a well-developed ulna, a well-developed fibula, and the teeth of simple pattern. So you are able, thanks to these great researches, to show that, so far as present knowledge extends, the history of the horse-type is exactly and precisely that which could have been predicted from a knowledge of the principles of evolution. And the knowledge we now possess justifies us completely in the anticipation that when the still lower Eocene deposits and those which belong to the Cretaceous epoch have yielded up their remains of equine animals, we shall find first an equine creature with four complete toes and a rudiment of the innermost toe in front, and probably a rudiment of the fifth toe in the hind-foot. (Since this lecture was delivered, Prof. Marsh has discovered in the lowest Eocene deposits of the West a new genus of equine mammals (*Eohippus*), which corresponds very nearly to this description.—*American Journal of Science*, November, 1876.) In still older forms the series of the digits will be more and more complete, until we come to the five-toed animals, in which most assuredly the whole series took its origin.

"That is what I mean, ladies and gentlemen, by demonstrative evidence of evolution. An inductive hypothesis is said to be demonstrated when the facts are shown to be in entire accordance with it. If that is not scientific proof, there are no inductive conclusions which can be said to be scientific. And the doctrine of evolution at the present time rests upon exactly as secure a foundation as the Copernican theory of the motions of the heavenly bodies. Its basis is precisely of the same character—the coincidence of the observed facts with theoretical requirements."

FAMILIAR TALK CONCERNING THE TEETH.

I have so many times been asked by my patients why it is possible for a tooth to ache after the nerve has been killed that I propose to try to explain to the readers of the *Journal*, in as simple a manner as possible, avoiding all technicalities, why such a seeming contradiction can occur. If a longitudinal section be made of a tooth, a cavity nearly corresponding in shape to the external contour of the tooth will be found. This cavity is prolonged into the root, or roots, if there be more than one, and opens by a minute orifice at the extremity of each. This is called the *pulp cavity* or *chamber*, while those portions extending into the roots are distinguished by the name of *pulp canals.* This pulp cavity is occupied by a highly vascular and nervous tissue, the *dental pulp*, which is continuous through the opening at the end of the root with the vessels and nerves which supply the teeth and adjacent parts. From this dental pulp, improperly called the nerve, the tooth derives most of its life. The popular idea that the pulp of a tooth is a nerve is not correct; on the contrary, it is composed of much the same elements as any vital tissue. It is from this pulp that the hard tissues of the tooth are developed, it being originally of nearly the size of its individual tooth, growing smaller as the tooth becomes more fully developed, until at last it occupies only a small portion of the tooth. The exterior of the pulp corresponds in shape with that of the tooth, so that if it be isolated completely from the tooth, its shape will indicate to which kind of tooth it belonged. Its blood-vessels and nerves are numerous, being connected with the general system by passing out through the minute orifice at the end of the root.

There is, however, another source from which the tooth derives life, namely, from its *peridontium.* Covering the roots of teeth is a delicate membrane containing an abundance of blood-vessels and nerves. It is intimately connected with the gum; also with a corresponding membrane covering the adjacent bone, as well as all bones in the body. For a more familiar term we will call it the *root membrane;* its correct name is *peridontium*, which signifies, "around a tooth." On bones, however, it is called periosteum. From this root membrane the tooth derives enough life so that if the pulp die from any cause the tooth will still be retained; which would not be the case if all its nutriment came from the pulp, for in that case, should the pulp die, the tooth would become a foreign substance, and Nature would at once set her forces at work to remove it, as she would a thorn or any other alien intruder. Thus we see that though the pulp is dead, there is still life remaining in the tooth, owing to the nourishment it receives from this root membrane; otherwise the tooth would not remain in its bony socket. It is from an inflammation of this root membrane (peridontium) that the pain arises when you have a toothache from a tooth in which the pulp has been devitalized; and I will now proceed to explain the causes which excite this irritation.

When from any cause the pulp of a tooth "gives up the ghost," what happens? The pulp, being dead, of course decomposes; and if allowed to remain in the tooth, the gasses arising from this decomposition must find a means of exit. If a cavity of decay exists, freely open (for pulps will die sometimes when not exposed by decay, as I will explain hereafter), the gases arising from the dead pulp will escape through the cavity, and no trouble results. But should this cavity be closed, either by the impaction of food, a filling, or any other cause, the gases, finding no other vent, are forced through the minute orifice at the end of the root, where the vessels entered which supplied it with life, irritating the root membrane of the tooth and the surrounding parts. This irritation causes inflammation, and as this progresses pus is formed.

The first indication we have of this variety of toothache, is a slight soreness on shutting the teeth together, or on striking the affected tooth. Soon the soreness increases, the tooth feels as if it was more prominent than the others, and one has a desire to be continually feeling of it, to see how things are progressing.

The pain is dull, throbbing and, owing to the parts being confined by hard, bony walls, severely intense, the whole jaw sympathizing. How will this state of things end? In one of two ways. Sometimes, in persons of good constitution, the trouble will after a while pass away, but, as a general rule, pus will keep forming, the face swelling, and finally, after almost unbearable agony, the pus will work its way through the bone and soft parts, forming what is known as a gum-boil (alveolar abscess), which at last breaks, and thus for a time will the trouble end. This is what is familiarly known as an ulcerated tooth.

What causes the death of the pulp? The most frequent cause is the application of some medicament by the dentist, to destroy it. This ought never to be done if it can be avoided, as there is in the majority of cases a much better way of treating them, if they are not too much diseased; namely, by carefully cleaning the parts, washing with tepid water, and protecting them with a soft, non-irritating filling, as every thoroughly educated dentist knows how to do. There are other causes, such as severe blows received upon the teeth, too close contact of metallic fillings, application of arsenic to allay sensitiveness in cavities of decay—which should never be done unless it be for the express purpose of devitalizing the pulp—and several other causes which I have not space here to name.

As it is often necessary to destroy these pulps, what should be done to guard against toothache of this variety? After the life of a pulp has been destroyed, by the application of medicine to it, or any other cause, it should be hardened and withdrawn from its cavity—which is not a painful operation—the parts thoroughly disinfected, and the cavity carefully filled. If teeth are treated in this way, the chances of trouble are greatly lessened, and they may be retained as useful organs for many years, and perhaps for a life-time. What shall we do if this trouble does arise? Consult a competent dentist, not one who has picked up a little knowledge of teeth, and is a mere extractor and plugger of these organs, but one who has been thoroughly and scientifically educated for his calling, and he will know what to do. In case for any reason this is impossible, you *may* be able to relieve yourself.

In the first place do not delay in hope that the tooth may feel better, but attend to it at once. Remove, if you can, all foreign matter from the cavity, thoroughly washing it with tepid water, and get an opening into the pulp chamber. This alone will often cure it. Paint the gum freely all around the tooth with strong tincture of iodine, first drying off the moisture from the gum. Hold ice-cold water or lumps of ice continually in the mouth, but should you start on this cold water method of treatment you must keep it up for several hours, or it will be worse than useless. Hot foot-baths and saline cathartics. Let the tooth alone, do not keep feeling of it, thus keeping up the irritation which you are trying to allay. Remember that this form of treatment is not applicable to an exposed living pulp, but only in cases where this organ is dead. Cold water applied to an inflamed living pulp would only increase your agony. Should you find that you cannot arrest the inflammation after sufficient trial, you will have to take the other course, and that is, to hasten suppuration by warm applications *directly to the part.* For this purpose nothing is better than a split fig, roasted and laid on the gum. Warm fluids held in the mouth will sometimes afford relief. But it is wiser to go at once to a competent dentist, as serious trouble often arises from this form of disease. Never on any consideration apply poultices on the outside of the face, for should the abscess point and break there, a permanent and unsightly scar would be the result.

In closing I would say that as "an ounce of prevention is better than a pound of cure," it would be much better to attend to your teeth in time, before the pulps become exposed, and save your teeth and yourself all this pain and trouble. You will never find any artificial teeth that will be the source of as much comfort as your own natural organs properly taken care of.—Geo. L. Parmele, M. D., *in Boston Journal of Chemistry.*

The French Vine Destroyer.—A correspondent of the *Pall Mall Gazette*, writing from Cognac under date of October 13, says: "Five years ago the French Minister of Agriculture offered a prize of 20,000 francs for the discovery of a means of ridding France of so disastrous a scourge (the phylloxera). Small as the prize was in comparison with the great interest at stake, it was sufficient to quicken the zeal alike of savans and empirics. Insecticide powders innumerable were brought into requisition; manure mixed with plaster, lime, sulphur, salt, soot and tar was successively tried; experiments were made with carbolic, arsenious and sulphuric acids, with sulphuret of carbon, creosote, ammonia and petroleum; the roots of the vines, too, were swaddled in green tobacco leaves, and in some localities attempts were made to eradicate the pest with fire. Some of these agents occasionally revived ailing plants, but failed to annihilate the phylloxera. Out of one hundred and forty supposed remedies which the Agricultural Society of Montpelier put to test, thirty-four produced some slight beneficial results, nine either injured or killed the vines, and the remaining ninety-seven exercised no influence whatever either for good or evil.

"Submersion of the vines under water appeared to be the only economic remedy that has been attended with real success. Efforts were made to apply this remedy on a large scale; and at a session of the Societe des Agriculteurs de France, M. Aristide Dumon, a well-known engineer, proposed to draw off a quantity of water from the Rhone, in the neighborhood of Condrieu, near where the famous Cote Rotie is grown, and by means of a canal to inundate some 20,000 acres of vineyards along the Cotes du Rhone. The subject was brought before the National Assembly, but the Budget Committee rejected the proposal on the plea of there being no funds available for digging the canal in question. Three years ago M. Planchon, a distinguished French naturalist, visited the United States, where he learned that certain species of American vines are left untouched by the phylloxera —thanks to the activity of a parasitic insect termed the "cannibal," which feeds upon the phylloxera with insatiable voracity. M. Planchon, delighted with his discovery, brought back with him a large number of these so-called cannibals, but, unluckily, did not succeed in multiplying them as he had hoped, so that the phylloxera is enabled to continue its ravages unchecked. Some time ago the French Government, alarmed at the extent of the devastation, offered a prize of 300,000 f. for an efficacious and economical means of arresting the further progress of this scourge of the vine; but although many have competed it still remains, and is likely to remain unawarded.

Hot Water for Injuries and Bruises.—The New York *Medical Journal* reports this case: The patient was engaged in a machine shop, and while his hand was upon the anvil of a trip-hammer, the hammer—weighing 700 pounds—fell. It so happened that a file was on the anvil, and in this way the force of the hammer was arrested about half an inch before it reached the bed. When the hand was examined it was found that the whole palm was a mass of pulp. The metacarpal bones were comminuted extensively, and there was, apparently, but small chance of saving the hand. It was, however, placed in hot water, and kept there for two or three weeks, and then taken out and dressed. In three months the patient was sufficiently well to leave the hospital, and now—nine months after the accident—he is able to move the fingers and has quite a useful hand. Bruises and injuries do much better when treated with hot than with cold water. The temperature should be about 103° Fahrenheit. Another case is reported of compound fracture and discoloration of the ankle joint, in which the proximate end of the first metatarsal bone protruded from the foot. The dislocation was reduced and the foot placed in hot water. At the end of a week it was taken out and dressed in the ordinary manner. The foot is now doing well and promises a good return.

Cold Baths in Typhoid Fever.—Dr. Mayet has lately furnished in the *Gazette Hebdomadaire* some interesting statistics from Lyons hospitals with regard to the treatment of typhoid fever with cold baths. It is shown that the patients thus treated, though taken from amongst those most seriously attacked, have always, since 1874, presented a less mortality than those who have been treated otherwise. He also points out to his colleagues that the mortality of typhoid patients has been increasing in the hospitals as the number of patients subjected to baths has been diminished.

REMEDY FOR SANDCRACKS.—The *English Live Stock Journal* published the following recipe for a preparation by means of which sandcracks or fractures in hoof or horn may be durably cemented up: Take one part of coarsely powdered gum-ammonia and two parts of gutta-percha the size of a hazel nut. Put them in a tin-lined vessel over a slow fire, and stir constantly until thoroughly mixed. Before the thick resinous mass gets cold mould it into sticks like sealing wax. The cement will keep for years, and when required for use it is only necessary to cut of a sufficient quantity, and remelt it again for application. The only precaution necessary for its successful application is the careful removal of all grease by spirits of sal-ammonia, sulphite of carbon or ether.

EDITORIAL NOTES.

Owing to an unexpected absence in the latter part of March we were unable to get the second number of the "REVIEW" out in that month, hence date it April. Such interruptions are very annoying, but as the "REVIEW" is not a newspaper no special harm has been done by the delay. Hereafter it is hoped that we will be able to issue each number promptly at the proper date.

THE POPULAR SCIENCE MONTHLY, April, 1877. D. Appleton & Co., New York. 128 pages. Fifty cents.

Promptly on time, this ever welcome journal greets us with a most attractive appearance, both in typography and paper, while to scientific readers the following table of contents presents a rare intellectual feast: A Combat with an Infected Atmosphere, by Prof. John Tyndall, F. R. S., illustrated; Relations of the Air to Our Clothing, by Dr. Max von Pettenkofer; Audubon's Lily Rediscovered, by Prof. Samuel Lockwood; The Plant-Eaters of North America, by Prof. Sanborn Tenney, illustrated; the Science *vs.* the Art of Chemistry, by Prof. Ira Remsen; Vital Statistics, by Charles P. Russel, M. D.; World-Creations, by C. C. Merriman, Esq.; Accoutrement of a Field Geologist, by Prof. Geikie, F. R. S., illustrated; On the

Annihilation of the Mind, by Prof. John Trowbridge; the First "Popular Scientific Treatise," by Prof. S. P. Langley; the Ball-Paradox, by Thomas S. Crane, C. E., illustrated; Laboratory Endowment, by Prof. F. W. Clarke; the Origin and Curiosities of the Arabic Numerals, by D. V. T. Qua; the Scientific Labors of William Crookes, with portrait; Correspondence; Editor's Table: International Copyright—the Order of Nature, etc.; Literary Notices: Smith's Notes on Life Insurance— Ferrier's Functions of the Brain —Barrett's Carlyle Anthology—New Encyclopædia of Chemistry, etc.; Popular Miscellany: Tyndall and Roberts on Spontaneous Generation—the Phenomena of Hypnotism—Further Experiments with Putrescible Fluids —a Solar Distillery—Meteorological—Preservation of Ice in the Sick Room, etc; Notes.

GRAY'S ATLAS OF THE UNITED STATES AND THE WORLD. Published by Milton R. Brown & Co. Compiled and drawn from the latest and most reliable authorities by O. W. GRAY & SON, Philadelphia, Pa. Sold by subscription by A. BROWN, Kansas City, Mo. $16.00.

This is the most complete and comprehensive atlas we have ever seen, comprising, as it does, over eighty imperial folio pages, showing counties, towns, river, lakes, mountains, railroads, canals, etc. There are six maps of the United States alone, showing separately the railroad system, the climatology, the geology, the zoology, the botany and the history. Equal care is taken to show clearly and fully the physical details of other countries, while the letter-press comprises a general description of the world, its form, density, temperature, meteorology, etc., etc., together with a climatological description of the United States, by Lorin Blodgett; a goelogical description by Prof. Chas. H. Hitchcock, etc., etc., besides distance, population and other statistical tables and reports of all kinds. Persons in need of a new atlas can hardly hope to find a better one than this, and the price is very reasonable, considering the size and quality of the work.

PUBLICATIONS RECEIVED.—Mineral Resources west of the Rocky Mountains, 1875; Seventh Annual Report of R. W. Raymond, United States Commissioner of Mining Statistics; Eighth Annual Report on the Noxious, Beneficial and Other Insects of the State of Missouri, by Charles V. Riley, State Entomologist; The American Meteorologist, February, 1877, Prof. J. H. Tice, editor, St. Louis, Mo.; Popular Science Monthly, April, 1877, Appleton & Co., New York; Boston Journal of Chemistry; Address before the St. Louis Academy of Science, by C. V. Riley, St. Louis, Mo.; The *Miami Republican*, Paola, Kas.; *Bates County Record*, Butler, Mo.

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ZOOLOGY.

ZOOLOGICAL GEOGRAPHY.*

The Neotropical Region, comprehending not only South America but Tropical North America and the Antilles, may be compared as to extent with the Ethiopian region; but it is distinguished from all the other great zoological divisions of the globe, by the small proportion of its surface occupied by deserts, by the large proportion of its lowlands, and by the altogether unequalled extent and luxuriance of its tropical forests. It further possesses a grand mountain range, rivalling the Himalayas in altitude and far surpassing them in extent, and which, being wholly situated within the region and running through eighty degrees of latitude, offers a variety of conditions and an extent of mountain slopes, of lofty plateaus and of deep valleys, which no other tropical region can approach. It has a further advantage in a southward prolongation far into the temperate zone, equivalent to a still greater extension of its lofty plateaus; and this has, no doubt, aided the development of the peculiar alpine forms of life which abound in the southern Andes. The climate of this region is exceptionally favorable. Owing to the lofty mountain range situated along its western margin, the moisture-laden trade winds from the Atlantic have free access

*From Wallace's Geographical Distribution of Animals. Part III. Harper Brothers, New York.

to the interior. A sufficient proportion of this moisture reaches the higher slopes of the Andes, where its condensation gives rise to innumerable streams, which cut deep ravines and carry down such an amount of sediment that they have formed the vast plains of the Amazon, of Paraguay, and of the Orinooko out of what were once, no doubt, arms of the sea, separating the large islands of Guiana, Brazil, and the Andes. From these concurrent favorable conditions, there has resulted that inexhaustible variety of generic and specific forms with a somewhat limited range of family and ordinal types, which characterise neotropical zoology to a degree nowhere else to be met with.

Together with this variety and richness, there is a remarkable uniformity of animal life over all the tropical continental portions of the region, so that its division into sub-regions is a matter of some difficulty. There is, however, no doubt about separating the West Indian islands as forming a well-marked subdivision; characterized, not only by that poverty of forms which is a general feature of ancient insular groups, but also by a number of peculiar generic types, some of which are quite foreign to the remainder of the region. We must exclude, however, the islands of Trinidad, Tobago, and a few other small islands near the coast, which zoologically form a part of the main land. Again, the South Temperate portion of the continent, together with the high plateaus of the Andes to near the equator, form a well-marked subdivision, characterized by a peculiar fauna, very distinct both positively and negatively from that of the tropical lowland districts. The rest of Tropical South America is so homogeneous in its forms of life that it cannot be conveniently subdivided for the purposes of a work like the present. There are, no doubt, considerable differences in various parts of its vast area, due partly to its having been once separated into three or more islands, in part to existing diversities of physical conditions; and more exact knowledge may enable us to form several provinces or perhaps additional sub-regions. A large proportion of the genera, however, when sufficiently numerous in species, range over almost the whole extent of this sub-region wherever the conditions are favorable. Even the Andes do not seem to form such a barrier as has been supposed. North of the equator, where its western slopes are moist and forest-clad, most of the genera are found on both sides. To the south of this line its western valleys are arid and its lower plains almost deserts; and thus the absence of a number of groups to which verdant forests are essential, can be traced to the unsuitable conditions rather than to the existence of the mountain barrier. All Tropical South America, therefore, is here considered to form but one sub-region.

The portion of North America that lies within the tropics, closely resembes the last sub-region in general zoological features. It possesses hardly any positive distinctions; but there are several of a negative character, many important groups being wholly confined to South America. On the other hand many genera range into Mexico and Gautemala from the north, which never reach South America; so that it is convenient to separate this district as a sub-region, which forms, to some extent, a transition to the Nearctic region. * * * * * *

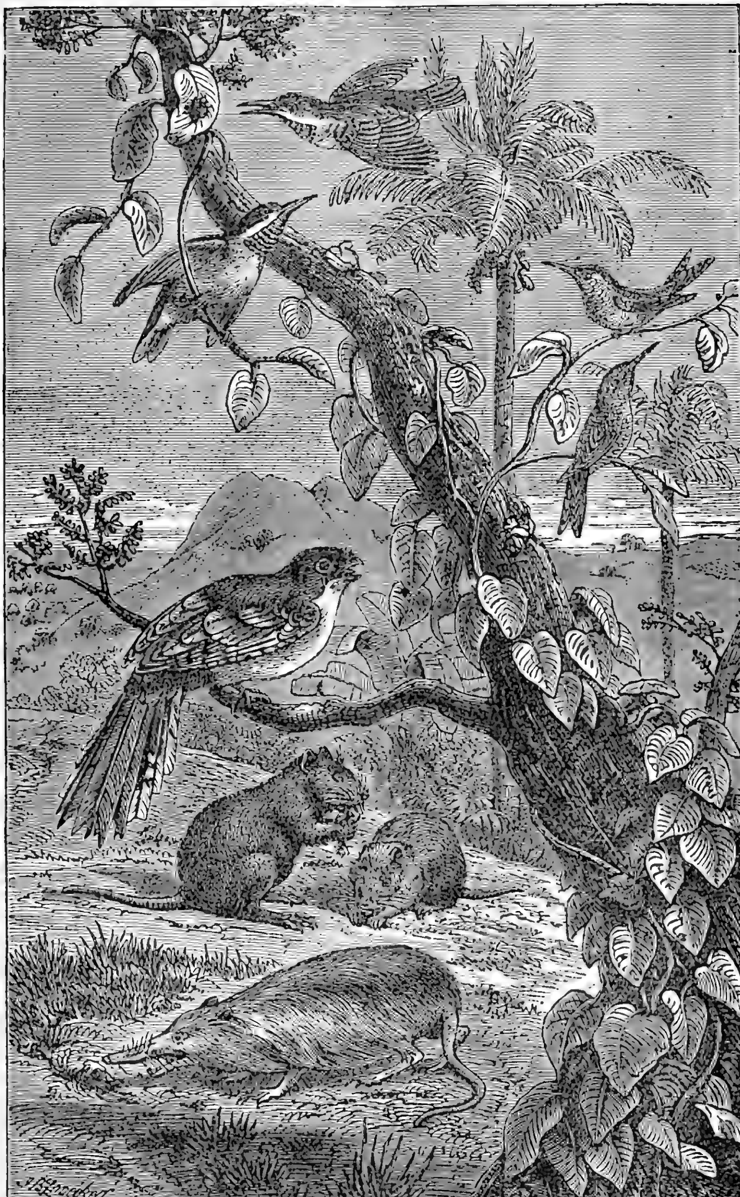
The West Indian Islands are, in many respects, one of the most interesting of zoological *sub-regions*. In position they form an unbroken chain uniting North and South America, in a line parallel to the great Central American isthmus; yet instead of exhibiting an intermixture of the productions of Florida and Venezuela, they differ widely from both these countries, possessing in some groups a degree of specialty only to be found elsewhere in islands far removed from any continent. They consist of two very large islands, Cuba and Hayti; two of moderate size, Jamaica and Portorico; and a chain of much smaller islands, St. Croix, Anguilla, Barbuda, Antigua, Guadaloupe, Dominica, Martinique, St. Lucia, St. Vincent, Barbadoes and Grenada, with a host of intervening islets. Tobago, Trinidad, Margarita and Curaçao, are situated in shallow water near the coast of South America, of which they form part zoologically. To the north of Cuba and Hayti are the Bahamas, an extensive group of coral reefs and islands, seven hundred miles long, and although very poor in animal life, belonging zoologically to the Antilles. All the larger islands, and most of the smaller ones (except those of coral formation) are very mountainous and rocky, the chains rising to about 8,000 feet in Hayti and Jamaica, and to nearly the same height in Cuba. All, except where they have been cleared by man, are covered with a luxuriant forest vegetation; the temperature is high and uniform; the rains ample; the soil, derived from granitic and limestone rocks, exceedingly fertile; and as the four larger islands together are larger than Great Britain, we might expect an ample and luxuriant fauna. The reverse is however the case; and there are probably no land areas on the globe, so highly favored by nature in all the essentials for supporting animal life, and at the same time so poor in all the more highly organized groups of animals. Before entering upon our sketch of the main features of this peculiar but limited fauna, it will be well to note a few peculiarities in the physical structure of the islands, which have an important bearing on their past history, and will enable us to account for much that is peculiar in the general character of their natural productions.

If we draw a line immediately south of St. Croix and St. Bartholomew, we shall divide the archipelago into two very different groups. The southern range of islands, or the Lesser Antilles, are, almost without exception, volcanic; beginning with the small detached volcanoes of Saba and St. Eustatius, and ending with the old volcano of Grenada. Barbuda and Antigua are low islands of tertiary or recent formation, connected with the volcanic islands by a submerged bank at no great depth. The islands to the north and west are none of them volcanic; many are very large, and these have a central nucleus of ancient or granitic rocks. We must also note, that the channels between these islands are not of excessive depth, and that their outlines, as well as the direction of their mountain ranges, point to a former union. Thus, the northern range of Hayti is continued westward in Cuba, and eastward in Portorico; while the southwestern peninsula extends in a direct line towards Jamaica, the depth between them being 600 fathoms. Between Portorico and Hayti there is only 250 fathoms; while close to the south of all these islands the sea is enormously deep, from more than 1,000 fathoms south of Cuba and Jamaica, to 2,000 south of Hayti, and 2,600 fathoms near the southeast extremity of Portorico. The importance of the division here pointed out will be seen, when we state that indigenous mammalia of peculiar genera are found on the western group of islands only; and it is on these that all the chief peculiarities of Antillian zoology are developed. * * * *

The scene of this illustration is Cuba, the largest of the West Indian islands, and one in which all its peculiar zoological features are well developed. In the foreground is the agouta (*Solenodon cubanus*), a remarkable insectiverous animal which, with another species inhabiting Hayti, has no allies on the American continent; nor anywhere in the world but in Madagascar, where a group of animals are found consisting of the family Centetidæ, to which *Solenodon* is said undoubtedly to belong. Above it are a pair of hutias (*Capromys fournieri*), rat-like animals belonging to the South American family Octodontidæ. They live in the forests, and climb trees readily, eating all kinds of vegetable food. Three species of the genus are known, which are found only in Cuba and Jamaica. Just above these animals is a white-breasted trogon (*Prionoteles temnurus*), confined to Cuba, and the only species of the genus. Near the top of the picture are a pair of todies (*Todus multicolor*), singular little insectiverous birds allied to the motmots, but forming a very distinct family which is confined to the islands of the Greater Antilles. They are beautifully-colored birds—green above, red and white beneath, and are exceedingly active in their movements. To the right are a pair of small humming-birds (*Sporadinus ricordi*), not very remarkable in this beautiful family, but introduced here because they belong to a genus which is confined to the the Greater Antilles. * *

The Nearctic Region consists almost wholly of Temperate North America as defined by physical geographers. In area it is about equal to the Neotropical region. It possesses a vast mountain range traversing its entire length from north to south, comparable with, and in fact a continuation of, the Andes—and a smaller range near the east coast, equally comparable with the mountains of Brazil and Guiana. These mountains supply its great river system of the Mississippi, second only to that of the Amazon; and in its vast group of fresh-water lakes or inland seas, it possesses a feature unmatched by any other region, except perhaps by the Ethiopian. It possesses every variety of climate between arctic and tropical; extensive forests and vast prairies; a greatly varied surface and a rich and beautiful flora. But these great advantages are somewhat neutralized by other physical features. It extends far towards the north, and there it reaches its greatest width; while in its southern and warmest portion it suddenly nar-

Plate XVII.



A Scene in Cuba, with Characteristic Animals.

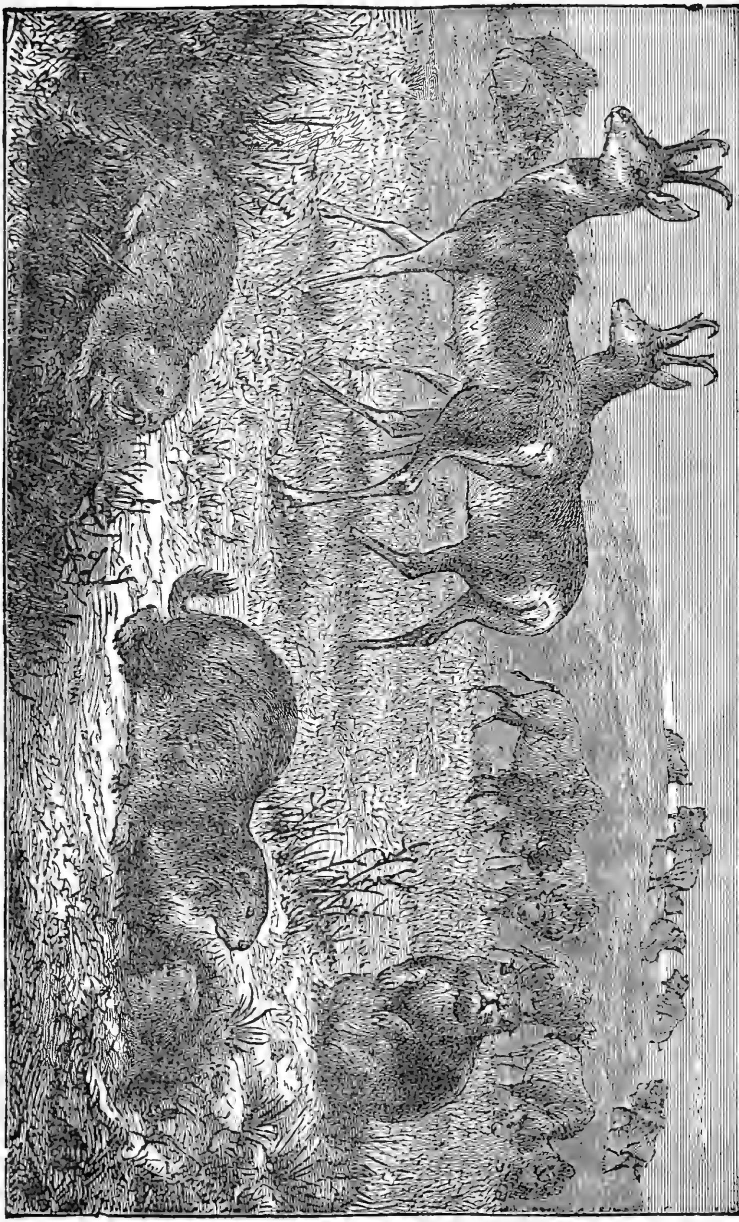
rows. The northern mass of land causes its isothermal lines to bend southwards; and its winter temperature especially, is far lower than at corresponding latitudes in Europe. This diminishes the available area for supporting animal life; the amount and character of which must be, to a great extent, determined by the nature of the least favorable part of the year. Again, owing to the position of its mountain ranges and the direction of prevalent winds, a large extent of its interior, east of the Rocky Mountains, is bare and arid, and often almost desert; while the most favored districts —those east of the Mississippi and west of the Sierra Nevada, bear but a small proportion to its whole area. Again, we know that at a very recent period geologically, it was subject to a very severe glacial epoch, which wrapped a full half of it in a mantle of ice, and exterminated a large number of animals which previously inhabited it. Taking all this into account, we need not be surprised to find the Nearctic region somewhat less rich and varied in its forms of life than the Palæarctic or the Australian regions, with which alone it can fairly be compared. The wonder rather is that it should be so little inferior to them in this respect, and that it should possess such a variety of groups, and such a multitude of forms, in every class of animals. * * * *

In our chapter on extinct animals, we have shown that there is good reason for believing that the existing union of North and South America is quite a recent occurrence; and that the separation was effected by an arm of the sea across what is now Nicaragua, with perhaps another at Panama. This would leave Mexico and Guatemala joined to North America, and forming part of the Nearctic region, although no doubt containing many Neotropical forms, which they had received during earlier continental periods; and these countries might at other times have been made insular by a strait at the isthmus of Tehuantepec, and have then developed some peculiar species. The latest climatal changes have tended to restrict these Neotropical forms to those parts where the climate is really tropical; and thus Mexico has attained its present strongly marked Neotropical character, although deficient in many of the most important groups of that region.

In view of these recent changes, it seems proper not to draw any decided line between the Nearctic and Neotropical regions, but rather to apply, in the case of each genus, a test which will show whether it was probably derived at a comparatively recent date from one region or the other. * * * *

The Central or Rocky Mountain sub-region is, for the greater part of its extent, from 2,000 to 5,000 feet above the sea, and is excessively arid; and, except in the immediate vicinity of streams and on some of the higher slopes of the mountains, is almost wholly treeless. Its zoology is therefore peculiar. Many of the most characteristic genera and families of the Eastern States are absent; while a number of curious desert and alpine forms give it a character of its own, and render it very interesting to the naturalist. * * * *

Plate XIX.



North American Prairies, with Characteristic Mammalia, We here introduce four of the most characteristic mammalia of the great American plains or prairies, three of them being types confined to North America. The graceful animals on the left are the prong-horned antelopes (*Antilocapra americana*), whose small horns, though hollow like those of the antelopes, are shed annually like those of the deer. To the right we have the prairie-dogs of the trappers (*Cynomys ludovicianus*) which, as will be easily seen, are rodents, and allied to the marmots of the European Alps. Their burrows are numerous on the prairies, and the manner in which they perch themselves on little mounds and gaze on intruders, is noticed by all travelers. On the left, in the foreground, is one of the extraordinary pouched rats of America (*Geomys bursarius*). There are burrowing animals, feeding on roots; and the mouth is, as it were, double, the outer portion very wide and hairy, behind which is the small inner mouth. Its use may be to keep out the earth from the mouth while the animal is gnawing roots. A mouth so constructed is found in no other animals but in these North American rats. In the distance is a herd of bisons (*Bison americanus*), the typical beast of the prairies. * * *

The remaining part of this volume will consist of a systematic review of the distribution of each family of animals, and an application of the principles already established to elucidate the chief phenomena they present. The present chapter must, therefore, be considered as the conclusion of the argumentative and theoretical part of the present work; but it must be read in connection with the various discussions in Parts II. and III., in which the conclusions to be drawn from the several groups of facts have been successively given; and especially in connection with the general observations at the end of each of the six chapters on the Zoological Regions.

The hypothetical view, as to the more recent of the great geographical changes of the earth's surface, here set forth, is not the result of any preconceived theory, but has grown out of a careful study of the facts accumulated, and has led to a considerable modification of the author's previous views. It may be described as an application of the general theory of Evolution, to solve the problem of the distribution of animals; but it also furnishes some independent support to that theory, both by showing what a great variety of curious facts are explained by its means, and by answering some of the objections, which have been founded on supposed difficulties in the distribution of animals in space and time.

It also illustrates and supports the geological doctrine of the general permanence of our great continents and oceans, by showing how many facts in the distribution of animals can only be explained and understood on such a supposition; and it exhibits, in a striking manner, the enormous influence of the Glacial epoch, in determining the existing zoological features of the various continents.

And, lastly, it furnishes a more consistent and intelligible idea than has yet been reached by any other mode of investigation, of all the more important changes of the earth's surface that have probably occurred during the entire Tertiary period; and of the influence of these changes, in bringing about the general features, as well as many of the more interesting details and puzzling anomalies of the Geographical Distribution of Animals.

MINERALOGY.

ANTIQUE MARBLES.

Nothing more forcibly attests the imperial power and magnificence of Rome, at the height of her glory, than the fragments of precious marble which almost every excavation among her ruins brings to sight. Even if her history were lost to us, these varied bits of stone would tell in language stronger than words the story of her universal dominion, when her ships sought every clime, and every land paid tribute to her luxury. This piece reflects the glowing suns of Numidia, that the green of Tempe's Vale; this was quarried on Pentelicus, this in storied Chios, and these tell of Gallic and of Hispanic conquest. Many have a double history, having served to decorate some forum or temple of the East before its spoilation by a Mummius or a Sulla.

Toward the end of the second century B. C. the Romans, who had become conversant with Greek art through their conquests, began to appreciate sculptures and precious marbles, and from that time onward almost every captured city was rifled of its treasures. Not only were all the quarries of the world put under contribution, but statues, columns and capitals, clabs, pavements, and sometimes entire edifices, were transported to Rome. Carthage, from the time of its destruction, furnished an almost inexhaustible supply. Edrisi, the Arab geographer of the twelfth century, says that marbles of so many different species were found among its ruins that it would be impossible to describe them. Blocks thirty feet high and sixty-three inches in diameter, and columns thirty feet in circumference, were taken out.

A large fleet of vessels was employed solely in transporting marbles, and slaves or freedmen were stationed in the various ports from which they were sent, who were charged with the duty of keeping account of the number, quality, and date of shipment of all stones. In 1868, excavations on the banks of the Tiber brought to light the ancient *marmorata*, or marble-wharf, where these vessels landed their cargoes. Many blocks of precious colored marbles were exhumed here, some of colossal proportions. One of yellow African marble was twenty-seven feet long by five and a half feet wide, and weighed thirty-four tons. Another, sent from a then newly-opened quarry in the mountains north of the Adriatic, to the Emperor Nero, was marked with the name of his freedman Carynthus.

So immense was the store of marbles amassed in Rome that for centuries after her spoilation by the northern barbarians her ruined edifices were regarded as the richest of quarries, from which pope, nobles and peasants drew at will. Most of the mediæval churches and other public edifices now extant are decorated with the spoils of imperial palaces, basilicas, baths, and the temples of the gods. Vast quantities of marble were even burned for lime; and, as if in retribution, Rome was robbed to beatify other cities. Her sculptured marbles were transported to Aix la-Chapelle to decorate the buildings of Charlemagne, and the ancient capital of the world, Petrarch laments, was forced to adorn from her own bowels the slothful luxury of Naples.

Of the white marbles of antiquity the most important were the Parian and the Pentelic, both the product of Greek quarries. The Parian was obtained from Mount Marpessa, in the island of Paros, one of the Cyclades, whence it was sometimes Marpessian. It was also called *lychnites*, because, says Pliny, the quarries were worked by lamplight. Dodwell disputes this, averring that the quarries are cut down the mountain side and open to the light; and he suggests that the marble was so called from its glittering fracture, or its translucence. This leads one to doubt whether Dodwell ever visited them, for Bory Saint-Vincent, of the French commission to the Morea, expressly describes them as subterranean, and says the entrance of the principal one was so filled up at the time of his visit that he was obliged to creep to enter it. There are three quarries on the mountain, and the largest has several lateral cuttings. The marks of the ancient wedges are everywhere visible, and it is evident from the manner in which the blocks were taken out that the utmost care was exercised to avoid waste. In consequence of the numerous fissures through the beds, comparatively small blocks could be obtained, generally not more than five feet in length.

Parian marble is of a yellowish white, very near the tint of white wax. Theocritus compares it to the color of teeth. It was, therefore, considered better adapted for the representation of human flesh than any other material. Its grain is much coarser than that of the Pentelic marble, but it takes a most exquisite polish, and, as it gradually hardens by exposure to atmospheric air, it resists decomposition for ages. To this quality is attributable the fine state of preservation of many of the most celebrated of the antique statues, such as the "Venus de' Medici, the "Diana Venatrix," the "Juno Capitolina," and "Ariadne," and the colossal "Minerva"—otherwise called the "Pallas of Velletri"—all of which are of Parian marble.

The neighboring island of Naxos produced a white marble scarcely inferior to that of Paros, but exhibiting a little more advanced state of crystallization. The marble, too, of Tenos, an island north of Paros, and of Thasos, the most northerly of the Ægean group, was considered nearly equal to that of Paros. Chios, Lesbos, Samos, and several other islands of the archipelago, also produced white marbles, generally of a more snowy white than the Parian. They are called usually by the Italians *marmo Greco.*

In the palmy days of Greek art the Athenians gave the preference to the Pentelic marble, rather than to that of Paros, probably because it was more accessible to Athens, the quarries being on Mount Pentelicus, only about eight miles from the city. It is finer in grain than the Parian, and is whiter, but it is less translucid, and it has a tendency to exfoliate under atmospheric influence, so that it loses in time its polished surface. It is marked, too, by occasional zones of greenish talc, whence it is called by the Italian sculptors *cipolino statuario*, from its resemblance to an onion (*cipola*). It is sometimes called also *marmo salino*, from its salt-like grains. The Parthenon, the Propylæa, the Erechtheum, and most of the other principal buildings of Athens, were constructed of Pentelic marble, and it was also the material of some of the most celebrated of the ancient statues, such as the "Venus" of the Capitol, the "Pallas" of the Albani villa, the "Indian Bacchus," and many portrait busts.

The Pentelic quarries, says Dodwell, are cut in perpendicular precipices in the side of the mountain. The marks of the tools are everywhere visible, and the tracks of the sledges on which the immense masses were drawn down the declivity to the plain are still to be seen. Several frustra of columns and other blocks lie at the base of the excavation, just as they were left by the ancient quarrymen. One of the larger excavations is worked now.

The Hymettan marble, from Mount Hymettus on the southeast side of Athens, was employed in Xenophon's time in the construction of temples, altars, shrines, and statues, throughout Greece, but especially in Athens. The Romans used it to a much greater extent than the Pentelic, partly because the quarries were nearer the sea, and partly because its peculiar tint became the fashion. It was of a much less brilliant white than the Pentelic, in some places becoming almost gray. It was used chiefly for buildings. According to Pliny, Lucius Scaurus was the first in Rome to decorate his house with Hymettan columns, 104 B. C. The statue of Meleager, in Paris, is made of this marble.

In the time of Julius Cæsar quarries of white marble were opened at Luna, on the coast of Eutruria, and thenceforth Rome drew her supply of building marbles from this place, almost to the exclusion of the Greek marbles. The Pantheon, and many other public buildings, were constructed of it. It was soon found to be adapted also for statuary, and finally came to be preferred to the Parian. The "Antinous" of the Capitol, now in the Paris Museum, is of this marble, and, according to some, the "Apollo Belvedere" also; but the Roman sculptors think the latter is a Greek marble. The marble of Luna, called by the ancients *marmor Lunense*, and which is the same as the modern Carrara, is whiter than either the Parian or Pentelic, and some of its veins are not inferior in beauty of grain and in softness to the former.

In 1847 a quarry of white marble was opened at Maremma, about thirty-five miles from Leghorn, which bore many evidences of having been worked in ancient times. It closely resembles the Parian in color and grain, works smoothly, and takes a high polish.

White marbles were also obtained by the ancients from Mount Phelleus, Rhamnus, and Sunium, in Attica; Demetrias, in Thessaly; on the river Sangarius, in Phrygia; from near Alexandria Troas; from Mount Prion, near Ephesus; from Cappadocia, and from Mount Libanus, the modern Lebanon.

The marbles of Phelleus, Rhamnus, and Sunium, were of good color, but were coarse, and less homogeneous than the Pentelic. The Sangarian marble was sometimes called Coralitic. The Cappadocian was called Phengites, on account of its translucence. The temple of Fortuna, built by Nero within the precincts of his Golden House, was built of this stone; and, although it had no windows, it is said to have been perfectly light when the door was closed. The marble of Mount Libanus, usually called Tyrian, was probably the material of Solomon's Temple and of Herod's palace. The *Scala Santa* in the Lateran Palace, Rome, said to have been brought from Pilate's house in Jerusalem, is of this marble, which is a clear blue-white.

The Proconnesian marble, a pure white with black veins, was quarried in the island of Proconnesus, in the Propontis. The celebrity of this stone has changed the name of the island to Marmora, and also given its modern name (Sea of Marmora) to the Propontis. This marble was also called Cyzican, because it was largely used in the city of Cyzicus, opposite the island of Mysia. The palace of Mausolus, at Halicarnassus, was built of it. It was also much used at Constantinople, under Honorius and the younger Theodosius. Several columns of it in the mosque of St. Sophia were spoils of the temple of Cybele at Cyzicus.

A white marble, with yellow spots, was brought from Cappadocia, and a similar marble from Rhodes, but the spots were of a brighter, more golden, yellow. White marble, with black spots, was quarried in the Troad.

But the most beautiful of the antique variegated marbles, with a white base, was the Synnadic, Docimæan, or Docimite, sometimes called *marmor Phrygium.* It was quarried at the village of Docimia, not far from Synnada, in Phrygia Major. The ancient authorities generally describe it as pure white, marked with red or purple veins, which the poets compared to the blood of Atys, slain at Synnada; but Hamilton, who visited the quarries about 1835, says that they yield several different kinds. He mentions white, bluish-white, white with yellow veins, white with blue veins, and white with blue spots, the latter having almost a brecciated appearance. He describes the principal quarry as worked horizontally into the hill, the sides of which are cut away perpendicularly to a great height to secure the splendid columns for which it was famous. Strabo says that pillars and slabs of surprising magnitude and beauty, approaching the alabastrite marble in variety of colors, were conveyed thence to Rome, notwithstanding the long land-carriage of more than one hundred miles to the place of shipment. The quarries are entirely surrounded by trachytic hills, to which, says Hamilton, the marble "owes its crystalline and altered character, being to all appearance a portion of the older secondary limestone caught up and developed by the protruded volcanic rocks, and crystallized by igneous action."

The alabastrites marble of the ancients, or onychites, was not a marble proper, but a hard carbonate of lime, identical in composition with stalagmite, the modern alabaster. It was quarried, says Pliny, near Thebes, in Egypt, and Damascus. When first brought to Rome it was considered almost a precious stone, and was made into cups and small ornaments, such as the feet of couches and chairs. When Balbus decorated his theatre, in the time of Augustus, with four small columns of this stone, it was noted as an unprecedented occurrence; but, in the reign of Claudius, Callistus, a freedman of that emperor, adorned his banquet hall with thirty large columns of alabastrites. The ancient quarries were reopened by Mehemet Ali, Viceroy of Egypt, to obtain material to build his mausoleum at Cairo. The four magnificent pillars of this marble that support the baldacchino over the altar in the church of San Paolo fuori le Mura, in Rome, were presented by him. Each is a monolith forty feet long.

Of the yellow marbles of antiquity, that called by the Italians *giallo antico* is the rarest and most beautiful. There are several varieties of it, varying in tint from a cream-yellow to the deepest chrome-yellow, sometimes shading into red and purple hues. Some is as bright as gold (*giallo dorato*), some of an orange-shade (*giallo capo*), and some, extremely rare, of a canary-color (*giallo paglia*). The ancient writers compared it to saffron, to sunlight and to ivory grown yellow with age. Some of it is variegated with black or dark-yellow rings. The grain is exceedingly fine. Its colors are derived entirely from carbonaceous matter. Among the finest existing specimens of this marble are the large columns in the Pantheon at Rome, and a single pair in the Arch of Constantine. The *giallo antico* was called *marmor Numidicum* by the Romans, but the precise site of the quarries is not yet ascertained. M. Fournel believes that the yellow marble of Philippeville, Algeria, which closely resembles it in varying tint, is identical with it. The island of Molos and Corinth also produced yellow marbles, and in the time of Justinian a marble of a fiery yellow was quarried in the neighborhood of Jerusalem.

Among the most celebrated marbles of the ancient world was the *rosso antico*, or red antique. Its color passes from a red, almost scarlet, to a wine-lees or blood-red, which is divided by parallel layers of white, and sometimes also intersected by a network of delicate black veins. Its variation in tint is probably according to the quantity of the oxide of iron contained in it. Until lately this marble was known only through its remains, and it has generally been ascribed to Egypt. The largest ancient specimens preserved are the fourteen slabs composing the double flight of steps in the church of San Prassede, Rome. Napoleon I. at one time intended to carry these to Paris to ornament his throne. There are several statues of *rosso antico*, including the "Antinous" in Paris, and the "Marcus Agrippa" in the Grimani Palace, Venice, and many medallion portraits. It is now ascertained that this beautiful marble was not Egyptian, but Greek. It was quarried on the coast of the gulf of Laconia, near what is now the bay of Scutari. The quarry lies near the sea, and large blocks cut by the ancients are still to be seen there. In 1851 the Greek government sent specimens from it to the London Exposition, and it was fully recognized as the *rosso antico*.

There are many varieties of the marble called red and white antique, but they are so near alike that it is impossible to distinguish them by description alone. They are variously called by the Italians *rosso annulato*, *serpentelo*, *vendurino*, *fiorito*, *cotonello*, etc. They are found only in the Roman ruins, and their quarries are unknown. The marble called *cervelas* is of a deep red, with numerous gray and white veins. It is supposed to have been brought from Africa.

The ancients were acquainted with many kinds of green marble, one of the most noted of which was the *marmor Atracium*, called by Julius Pollux Thessalian, and identical with the *verde antico* of the Italians. The quarries were on Mount Ossa, near the entrance of the vale of Tempe, and not far from Atrax in Thessaly, whence it derived its name. It is a species of breccia, whose paste is a mixture of talc and limestone, interspersed with fragments of white marble. But the verde antique marbles differ from the modern breccias in that the colors are so blended that the line of demarkation is not perceptible. The Erechtheum in Athens was adorned with columns of verde antique, and it was one of the marbles selected by Justinian for the decoration of St, Sophia. The eight splendid columns of it still to be seen in the mosque are said to have been taken from the temple of Diana at Ephesus.

The celebrated Carystian marble, the *cipolino verde* of the Italian, derived its name from Carystus, a town at the foot of Mount Oche, in the island of Eubæa, where it was quarried. The temple of Apollo Marmarinus of Carystus was named from this quarry. It is a true steatitic limestone or cipolin, and is of a beautiful grayish green, with white zones and spots, and sometimes sprinkled with different colors. It was easily obtained in very large blocks, suitable for columns, and was largely used in the temples and other public buildings in Athens and Rome. An English traveler, who visited the quarry lately, found seven entire columns on the site, about three miles from the sea, just as they were left by the ancient workmen,

The *marmor Lacedæmonium*, *Laconicum*, or *Spartum*, of the Romans has always been regarded as a species of verde-antique marble. Clarke says that it differed from the Atracian only in being variegated with black or dark-green serpentine instead of with white. But M. Boblaye, the mineralogist of the French commission to the Morea, has proved pretty conclusively that it was not a marble but a true porphyry, and probably identical with the *ophites* of the ancients, which Pliny says was so called from its resemblance to the skin of a serpent. Pausanias calls it Crocean stone. The French discovered the quarries near the ancient Croceæ, on the road from Sparta to Gythium, and about two miles from the modern village of Levétzova, in Laconia. The stone is of a dark grass-green, strewed with little parallelograms of a lighter green, sometimes approaching white and sometimes yellow. Procopius compares its color to emerald, and Statius and Sidonius call it a grass-green. Eurycles, the Spartan architect, used this stone in decorating the baths of Neptune at Corinth; and it was quarried to a large extent by the Romans, who enriched the monuments of Greece, Italy and Gaul, with it.

The Augustan and Tiberian marbles, so fashionable in Rome under those emperors, were obtained in Egypt. They are breccias composed of fragments of greenstone, gneiss and porphyry cemented with a calcareous paste. They are similar in color, a bright green, spotted and streaked with dark green, reddish gray and white; the only difference being, according to Pliny, that in the Augustan the figures undulate and curl to a point, while in the Tiberian the streaks are not involved, but lie wide asunder. It is probable that these marbles were quarried in the mountains between Thebes and the Red Sea. Inscriptions in the ancient quarries there, near the well of Hammamat, show that they were worked in the sixth dynasty of Manetho. A green marble called Memphites was quarried near Memphis in Egypt.

There were many other varieties of green marble known to the ancients, such as the red-spotted green antique, having a dark-green ground marked with small red and black spots and white fragments of *entrochi;* the *marmo verde paglioco*, yellowish green; and leek marble, of the color of a leek; but they exist only in small fragments, and their quarries are unknown. Another variety of green marble was found in the island of Tenos.

A blue marble is said to have been obtained in Libya. The island of Naxos yields a dark blue elegantly striped with white, Tenos a light blue veined with dark blue, and Scyros many kinds of blue and violet breccias, with other colors variously disposed. Scyros was one of the chief places whence the ancients derived their variegated marbles, and its quarries furnished many varieties closely resembling the famous marbles of other localities. Strabo says it produced the Carystian, Deucalian, Synnadic, and Hierapolitic marbles. The quarries of Tenos are still worked to some extent, but those of Scyros aud Naxos remain almost as the ancients left them.

Of the black marbles of antiquity that now called *nero antico*, or black antique, was the most celebrated. It is more intensely black than any marble now quarried, the black marbles of France appearing almost gray beside it. It occurs only in sculptured pieces, and its origin is unknown; but Faujas discovered a quarry which had been worked by the ancients, about two leagues from Spa, not far from Aix-la-Chapelle, the marble of which closely resembles the ancient specimens. The largest masses known of *nero antico* are two columns in the church of Regina Cœli at Rome, but there are also some fine specimens in the Museum of the Capitol and in other collections. Some suppose it to be indentical with the *marmor Lucullum*, which was introduced at Rome, by Lucullus, in the first century B. C., according to Pliny from Melos (another reading is Chios), but according to other authorities from Egypt or Libya, whence it is sometimes called *marmor Libycum*. Pliny says that Marcus Scaurus had pillars of it thirty-eight feet high in the atrium of his house. The Chian marble, a deep, transparent black, sometimes variegated with other colors, was quarried on Mount Pelinæus, in the island of Chios. A fine black marble was quarried on Mount Tænarus, in Laconia, and in the island of Lesbos, and a blue-black marble in Lydia. One of the most beautiful of the antique breccias, the African breccia, has a deep-black ground, variegated with fragments of grayish white and deep red or purplish wine-color. The grand antique breccia consists of large fragments of black marble united by veins of shining white. Columns of this and of African breccia are in the Paris Museum, but their quarries are unknown.—JOHN D. CHAMPLIN, JR., *in Popular Science Monthly*, May, 1877.

THE MINERAL RESOURCES OF MISSOURI

The growth of Missouri in population, wealth, material progress, in the means of intercommunication by her rail and water ways, challenges the admiration of the civilized world. The State of Missouri is larger in its area than the States of Maine, New Hampshire, Vermont, Rhode Island and Connecticut together, Missouri having an area of 67,380, while the New England States embrace but 66,124 square miles. Missouri has a greater variety of soil, a more genial climate and a more desirable combination of the elements that tend to the permanent prosperity of a people than any of the other States in the Union. Doubly blessed is she indeed ; with her certain harvest of rich crops on the surface, and her boundless mineral wealth overflowing nature's storehouse beneath.

Missouri within her boundaries contains a greater variety and larger quantities of the most useful minerals than any other territory of the same extent on the American Continent.

Coal and iron afford the most permanent basis of commercial and manufacturing prosperity. It is the coal and iron deposits that have contributed in the greatest measure to the building up of the most powerful nations of the earth, and it is not difficult to see the magnificent future of this great State, when her mineral interests shall be as thoroughly organized and perfectly systematized as are these interests in the old world. A celebrated writer says and truly, that "Coal is now the indispensable aliment of industry: it is a primary, material, engendering force, giving a power superior to that which natural agents, such as water, air, etc., procure. It is to industry what oxygen is to the lungs, water to the plants, nourishment to the animal. It is to coal that we owe steam and gas. Our coal fields have an area of 26,800 square miles of the regular coal measures, extending through thirty-three counties of the State, viz: Clark, Lewis, Scotland, Adair, Macon, Shelby, Monroe, Audrain, Callaway, Boone, Cooper, Pettis, Henry, Benton, St. Clair, Bates, Vernon, Cedar, Dade, Barton, Johnson, Lafayette, Cass, Chariton, Howard, Saline, Putnam, Carroll, Ray, Ralls, Montgomery, Warren and St. Louis. Now, if the average thickness of workable coal be one foot only, it would give 26,800,000 tons to the whole area occupied by coal rocks. Experience shows us that we can depend on five feet average thickness as the least possible result, which would give us 134,000,000 tons of good coal. Besides, we have local deposits of cannel and bituminous coal in Moniteau, Cole, Morgan, Crawford, Lincoln, Callaway and probably in other counties. Missouri contains an almost inexhaustible supply of iron ores of the best qualities and more available than can be found in any other place on the globe, and even now in the infancy of its development, there is more capital invested in the mining, shipping, smelting and manufacturing of the ores of iron than in all the other metal industries of the State. The iron ores of Missouri are red hematite, red oxide, specular, brown hematite or limonite, hydrous oxide, oxidulous or magnetic, spathic or carbonate of iron, and almost every other character and condition of iron known. Iron has been discovered in 62 counties of the State, in 19 of which it is being successfully mined, viz: Benton, Camden, Cedar, Crawford, Dent, Franklin, Henry, Iron, Madison, Maries, Miller, Morgan, Perry, Phelps, St. Francois, Saline, Shannon, Taney and Wayne. There are unmistakable evidences of heavy deposits, that only avait development in 27 counties, viz: Barry, Barton, Bollinger, Callaway, Christian, Cole, Cooper, Dallas, Dale, Douglas, Gasconade, Greene, Howell, Jefferson, Laclede, Lincoln, Monroe, Newton, Pulaski, Reynolds, St. Clair, Ste. Genevieve, Stoddard, Texas, Wayne, Washington and Webster. There are also indications of iron ores in 16 counties, viz: Boone, Butler, Camden, Clark, McDonald, Montgomery, Oregon, Osage, Pettis, Ray, Ripley, St. Louis, Scott, Stone, Vernon and Wright.

The lead deposits of Missouri hold out to the capitalist a most desirable field for the investment of money, with a certainty of large returns. There is no country of equal area on the globe that possesses one-half the extent and variety in lead deposits that our State can claim. From 60 to 85 per cent. of the ore is pure lead, and in some portions of the State it comes to the very surface of the ground. For a long time the hunters of Missouri have been accustomed to break out these croppings of lead for the manufacture of bullets. There has been no deep lead mining, yet Missouri ranks as the leading lead producing State. What will be her revenue from this branch of industry, when deep shafts shall be sent into the almost solid lake of pure lead that is known to exist, it is impossible to estimate. Lead has been found in 61 counties of Missouri, of which there are but 27 counties that are being worked, viz: Camden, Christian, Cole, Dallas, Dent, Franklin, Henry, Hickory, Iron, Jasper, Jefferson, Lawrence, McDonald, Madison, Maries, Miller, Moniteau, Morgan, Newton, Perry, Reynolds, St. Francois, Saline, Shannon, Washington, Webster and Wright. The counties in which lead mining is not developed, although it is know to exist in paying quantities, are 14, viz: Barry, Barton, Bollinger, Cooper, Crawford, Douglas, Greene, Howell, Laclede, Ripley, Ste. Genevieve, Texas, Warren and Wayne. There are also strong traces of lead in 20 counties, viz: Benton, Boone, Carroll, Clark, Clay, Dade, Oregon, Osage, Pettis, Phelps, Polk, Pulaski, Ray, Ripley, St. Louis, Schuyler, Scott, Stoddard, Stone and Vernon, but it will necessitate more thorough explorations to tell if in these latter counties lead can be procured in paying quantities. Copper has been found in 19 counties that give promise of yielding profitable results. In several localities it lies at an average of about 15 feet below the surface, the deposits being several feet thick and paying about 50 per cent. of pure copper. Zinc ore is abundant, but until recently it had no commercial value, and thousands of tons of the sulphuret of zinc were thrown away as worthless by the lead miners, who found it an impediment in lead mining. *Tin* ores have been found in large quantities, and so rich in metal that considerable capital has been spent in efforts to mine and reduce them, but as yet without pecuniary success. *Gold* has been found in two or three counties, but has never been profitably worked. Silver has been discovered in regular lodes in five counties, and in small quantities in nearly all the lead mines of the State, in combination with lead. *Cobalt* exists in considerable quantities at Mine La Motte, and it has also been found in one other locality. *Nickel* is worked at Mine La Motte—it is abundant and of good quality. *Antimony* has been discovered in large quantities in Cedar, Ste. Genevieve and other counties. Saltpetre has been found in a number of different localities, but as yet none has been manufactured. Platinum has been reported as existing in Madison county, but nothing has been found to substantiate the assertion. Marble in Missouri is found in numerous and extensive beds, of various shades and qualities, and will become a very important item of the State resources. *Limestone.*—There is a great variety of limestone in all parts of Missouri. *Hydraulic Limes* have been found and tested in numerous localities and found to possess first-class properties. *Sulphate of Baryta* is very abundant in this state. It is largely utilized as a pigment in connection with lead. Kaoline, from which ironstone china is manufactured, has been found in several localities, and worked in one or two. *Clays.*—Potters', brick and fire-clays have been found and worked in numerous parts of the State. *Paints.*—There are several beds of mineral paints in Missouri of the finest qualities. Sandstones are abundant, of various shades and color, that make them readily valuable for architectural purposes. *Granite and Sienite* of numerous qualities occur in this State. The most abundant is the red, cross-grained granite, which is very beautiful, particularly adapted for massive and strong work in building. *Road Materials.*—Missouri has an abundant supply of street and road materials. Limestone of the hardest and most durable kinds occurring everywhere, while Madison and the adjoining counties produce green stone, trap, sienite and gray granite, which make most excellent block paving. Thus imperfectly, without any desire to exaggerate, we present a general view of the mineral deposits of Missouri, and no argument is needed to convince the candid reader that if the developments of the mineral resources of the State are pushed forward in the future as they have been recently, our great State will rise up in her glory and wear the crown as queen of the empire.

CHEMISTRY.

Remarks upon the Prevention and Extinguishment of Conflagrations, by Theo. S. Case. Read before the Kansas City Academy of Sciences, April 25, 1876.

(REPUBLISHED BY REQUEST.)

In these days of frequent conflagrations and expensive insurance this subject demands the attention and action not only of the scientific man, but also of the prudent and economical house builder and owner; and in treating it I have adopted the plainest and most practical method and terms; believing that a Society like this can make itself fully as useful to and perhaps more popular in the community where it exists by sometimes discussing practical matters than by giving itself up at all times to abstruse investigations and theories.

Taking the heads of the subjects in their natural order, I have divided that of

PREVENTION

as follows, viz:

1. Prevention by the exclusion of oxygen and atmospheric air.
2. Prevention by fire-proof coatings of the combustible materials used in the construction of our buildings.
3. Prevention by rendering such materials themselves essentially incombustible.
4. Prevention by rendering bedding, clothing, scenery of theatres, etc., incombustible.
5. Prevention by mechanical obstructions, such as fire-walls, etc.
6. Prevention by the avoidance of the causes of spontaneous combustion.

Combustion is defined to be "the rapid and violent oxidation of carbon and hydrogen by the aid of the free oxygen of the atmosphere," *i. e.* all ordinary combustion is dependent upon the presence of oxygen, and cannot continue in its absence.

I. The first practical inference then that we draw is to so construct our buildings as to prevent the free admission and passage of atmospheric air, which contains so large a proportion of oxygen, to and through those inaccessible portions, such as the spaces under floors and within partitions, where fires so frequently originate and whence they spread so rapidly. Almost every person present will recall one or more instances where a destructive fire originated in or was caused by the ignition of the base-board of a room from to the too great proximity of a red-hot stove, the immediate extension of the flames within the lath and plaster partition and their rapid spread throughout the building by means of the upward draught of air between the studding. Now, had the partitions in such cases been of brick, or even lath and plaster rendered solid in any way, the draught could not have existed and the flames would have had no tendency whatever to pass within the partition. While this will be the case no matter what materials may be selected for solidifying purposes, manifestly it will be better to choose those that are least combustible and cheapest; and I know of none cheaper, more effectual and more readily and easily applied than the very same lime and sand mortar which constitutes the first coat of plastering upon such partitions. (So far lime has been found to resist all degrees of heat, not even being volatilized or fused in the hottest blast furnaces, while sand is almost equally incombustible). In an ordinary six inch lath and plaster partition, the studding commonly used is two inches by four, set with the four inch side transversely to the line of the wall. The plasterer, in putting on the mortar, forces it through the interstices of the lath from half to three quarters of an inch on both sides, thus leaving a space of from two and one-half to three inches wide between these keys, as they are called, which gives free passage for the air and flames as before described. Suppose in constructing such partitions, the studding pieces were turned the other way, *i. e.*, with the two-inch side transverse to the line of the wall, then the space between the keys of the mortar would be but from half an inch to one inch in width, which could be very cheaply and easily filled by the plasterer as he progressed with his work, and the partition thus rendered solid, impervious to air and flame, not less substantial than before, not enough heavier to do any harm, far less communicative of sound from room to room, and lastly, permanently obstructive to the passage of vermin of all kinds.

Similarly, the spaces between the floors and ceilings of different rooms could be filled with some cheap material, the more incombustible the better, which would serve the purpose of obstructing the spread of fire, at the same time that it performed the very useful functions of deadening sound and preventing such spaces being used as harbors and thoroughfares for rats and mice. In the Italian and French cities this principle is carefully observed in the construction of all classes of buildings, and it is very rare indeed that a fire in one of them spreads beyond the room in which it originates, even should the stock of goods or other contents be entirely destroyed.

The same reasoning applies to a considerable extent to the construction of staircases, halls and elevators in public buildings, hotels and dwellings, which, in many cases, become and serve as swift conductors of fire.

Most of you will recall the burning of the Fifth Avenue hotel, in New York, a few years since (and more recently, the Southern hotel, in St. Louis, Missouri), at which times a number of lives were lost and much property destroyed, simply from the fact that the flames of a fire originating in one of the lower stories were drawn, as through a tall flue, up the passage-way of an elevator and through the halls, thus communicating almost simultaneously with the whole six or seven stories and cutting off the sole means of escape for many of the occupants of the house.

No stairway should ascend continuously from bottom to top of tall buildings without being provided with some effective means for cutting off the current of air between the different floors. No hall should extend from end to end or side to side of our large asylums, seminaries or hotels without being furnished with iron doors which, in case of fire, could be easily closed and effectually secured, so as to cut off the draught of air through them, thus checking the rapid spread of the flames and giving the inmates a chance to escape with their lives, if no more. A very small expense, comparatively, for such doors for hallways and for appliances for closing the well-holes of staircases and the hatchways of elevators on each floor, were they nothing more than curtains of some substantial woolen stuff which could be quickly stretched and fastened over the openings, might, in many instances, save costly buildings and preserve valuable human lives. (Since writing the above I am informed that Vassar college is provided with iron doors for the hallways).

The apparent impossibility of rendering buildings absolutely fire-proof has been abundantly demonstrated by the ever memorable conflagrations of Chicago and Boston, where massive structures of iron, granite, marble and brick, upon which immense sums had been expended to render them incombustible, were swept away and consumed almost like straw or paper. This being for the present admitted to be the case, we will turn our attention to such details in the construction of our buildings as will enable them to resist primary ignition under ordinary exposure and sufficiently retard the combustion after ignition to give time for applying the means of extinguishment before the heat is too great to be overcome. Much may be done by the use of iron beams, rafters, joists, floors, lath, roofs and cornices in buildings of stone and brick, but as such buildings can only be erected at great expense, and as it is not to be expected that the use of wood as a building material will ever be abandoned, we will confine ourselves to looking for some method of placing these inflammable materials in the condition above described; which brings us to the second point in the consideration of the prevention of conflagrations, viz:

II. The use of fire-proof coatings upon the combustible portions of our buildings.

As you are well aware, the great majority of buildings erected all over the country are at least finished with pine lumber saturated with turpentine and resin, and which is afterward rendered still more inflammable by coverings of paint, composed of oils, turpentine, naptha and other ingredients of like character, while very many are constructed wholly, from roof to foundation, of such materials, and hence offer an attraction rather than any resistance to the flames. It is to this class of structures that my remarks chiefly apply, because they are the most numerous and probably always will be. They belong to a class of citizens who must build cheap houses, and who can least afford to lose them. They contain within themselves all of the essentials and very few of the obstructions to combustion; and finally, they are more liable to communicate the flames to adjoining buildings.

Numerous fire-proof paints have been prepared, and many patented; very few, however, have come into general use, owing in some cases to the fact that they were not preservers of wood as well as protectors against fire, and in others to the fact that they could not be applied in tasteful colors suitable for the inside finish of dwellings and stores. Among those presenting the best indications of accomplishing the objects desired are those composed of "water glass," as it is called, being chemically a silicate of potash or soda in a fluid state, which, being applied as any other paint, gives a hard, fire-proof coating to the wood, and may be tinted or colored with any pigment which is not acted upon by it. Several silicious paints have been proposed, all of which depend for their base upon the "water glass," the other ingredients, such as ochre, clay, steatite, etc., being added only to give body to the mixture. Paints of this kind have effectually protected wooden buildings against fierce flames for twenty to thirty minutes—long enough to give their inmates or the fire department ample time to apply competent means of extinguishment, and showing that no ordinary heat, such as might be thrown out by a red hot stove, a burning curtain, or even a gas burner carelessly pushed against it would be liable to ignite a piece of woodwork covered with them. Other paints are highly recommended, which are composed essentially of biborate of soda or common borax. Mons. Patera recommends a mixture of equal parts of borax and epsom salts. Chloride of zinc, with oxide of zinc and cream of tartar mixed in starch to the proper consistency gives a paint which is regarded as equal in every way to any lead or zinc oil paint, besides rendering wood almost incombustible, which quality is increased by the addition of a small amount of borax. Another coating highly recommended as fire-proof is composed of a mixture of one-third sulphate of ammonia and two-thirds sulphate of zinc; still another is composed of a mixture of sulphate of alumina with sulphate of iron, clay, etc. A French journal recommends washing the wood-work with a solution of ordinary pearl ash, then applying several coats of the same, thickened with clay and flour paste, after which a composition of glue thickened with iron filings, pulverized brick and ashes; this will resist fire for five hours and prevent the wood from ever bursting into flames, *i. e.*, cause it to so resist the ravages of fire as at most only to be reduced to coals and ashes, without increasing the conflagration by additional flames. Under most circumstances lime mortar is found to resist the spread of the flames about as effectually as any other coating, besides being far cheaper than most of them. A writer in the London *Science Review* for September, 1872, states that after the conflagration of Paris is was generally found that with good plaster-work over them beams and columns of wood were entirely protected from the fires. In cases where limestone walls had been utterly ruined on the outside by the flames, the same wall internally escaped almost unscathed, owing to their being coated with plaster. Stone staircases well protected by plaster were fire-proof.

Thus it will be observed that the alkalies and the alkaline earths possess remarkable fire-proof qualities, and that paints and other coatings composed of them wholly or in part may be depended upon to at least materially retard the progress of the flames in any ordinary case of fire, if not to check them altogether. It will also be noticed as we progress in the discussion of this subject that they figure prominently in nearly all of the proposed means for preventing the spread of the flames in conflagrations.

In the few experiments I myself have made with fire-proof coatings, I have found none superior to those first named, viz: the water glass compositions, in efficiency and applicability to fine work. I think for use in cheap structures, more especially factories and warehouses where inflammable materials are handled, a mixture of animal glue with ashes and lime or salt will be found much cheaper and nearly as efficient.

Such coatings as these are also especially and imperatively demanded in our steamboats, public halls and theaters, where the otherwise rapid combustion of the light and fanciful wood-work, curtains and scenery endangers human life more than almost any other circumstances.

III. The grand object, however, of all of our investigations in this direction, is the discovery of some means of rendering the substance of the wood itself incombustible. Having accomplished this, we may regard our houses as quite safe, and not before, for as long as it is impossible to exclude the air from them or build them perfectly solid, fires are liable to be kindled and will spread, and no matter with what coatings we may cover the wood-work, long continued and fierce heat will crack them off or penetrate to the inflammable material beneath; but when we can render the wood itself actually fire-proof, at so low a price as to give the benefit of the discovery to all, conflagrations need no longer be feared; for a material of this kind will be found superior to stone, brick and even iron itself in adaptability for building purposes.

At this point I desire to digress briefly, to point out the advantages which would be possessed by wood rendered incombustible over those materials ordinarily used by persons undertaking to construct fire-proof buildings, viz: stone or iron.

1. Such timbers would be more easily and readily transported, worked, handled and fitted, than either stone or iron.

2. They would not crumble or disintegrate under exposure to heat, as did the granites, sandstones and marbles of Chicago and Boston.

3. They would not expand under similar exposure and overthrow the buildings they were intended to support, as it is the well known tendency of iron columns, beams and joist.

4. They would not at a heat of from 1200° to 1500° F. become soft, as is the case with cast iron when red hot, and liable to yield to a superimposed pressure which it would really support when cold.

5. They would not be cracked or fractured by the application of water to them when hot, as is the fact concerning both stone and iron.

6. They would not under any circumstances tend to ignite spontaneously themselves nor produce the ignition of adjoining inflammable materials, as is believed by scientific men be the case with iron when oxidizing in contact with wood or other combustible substances.

Under none of the circumstances named above will wood which has been rendered fully fire-proof be unfavorably affected, but on the contrary it will resist all of the effects of heat upon stone and iron just given, besides some others of minor importance.

Numerous attempts have been made to achieve this desirable result, but as yet no certain success has been reached. Among the various substances suggested for the purpose are sulphate of iron or copperas, sulphate of lime or gypsum, and various other salts, mostly of the alkalies, with which it is proposed to fill the pores of the wood. That success may be reached in this way there is no reasonable doubt, for even dry gunpowder itself may be prevented from burning by separating its particles by means of almost any incombustible material pulverized and mixed with it, such as earth, sand, powdered glass, etc.; but the difficulty seems to be to find some means of introducing the protecting salts into the wood less expensive and elaborate than any yet proposed.

The present methods are to first prepare the wood by kiln drying, to deprive it of its moisture and volatile oils, then by great pressure force the preservative fluids into the open pores of the wood; or, to exhaust the air, moisture, etc., *in vacuo* and then introduce the salts by atmospheric pressure alone. Still another plan is to displace the fluids in the lumber by columnar pressure, as an apothecary displaces one fluid with another in preparing his tinctures; all of which methods are expensive and troublesome.

An English clergyman, by soaking the wood in a solution of tungstate of soda, succeeded in rendering it completely impervious to fire. The following were some of his experiments: "Two small pyramids of sticks were made, one of prepared wood and the other of unprepared wood. These were then saturated with paraffine and ignited. In the case of the prepared wood the paraffine soon burned itself out without communicating the flames to the wood, which was only slightly charred. The other heap burned fiercely, and in half an hour was reduced to ashes. The next experiment was made with two wooden huts, one of which had been prepared, while the other, built of ordinary Scotch fir, had not. A strong fire, sufficient to ignite the houses, was made in each, and the effect was the same as in the previous experiment. A chest containing a parchment document, was treated by the process and was thrown into the flames when at their height, and was taken out sometime afterwards, charred indeed on the outside, but uninjured in every other respect. The inside was quite cool, and the wax seals on the document were intact. Perhaps the most important trial was that which took place with gunpowder. A government keg, which had been rendered fire-proof, was used. A paper packet containing two ounces of gunpowder was put in the bottom of the keg, and a sheet of brown paper impregnated with the tungstate was pasted over it and dried. The keg, which was open at the top, was turned upside down and surrounded by shavings, which were lighted. A fire of petroleum and shavings was kept burning on the top fifteen minutes without producing the slightest effect on the keg. To make the trial still more complete, the keg was reversed again, and lighted shavings were thrown upon the gunpowder protected only by a sheet of brown paper. The paper stood the test admirably, and the solution rejected the fire so thoroughly that the paper did not show even a sign of charring. The gunpowder was then taken out and exploded."

Messrs. Moore & Weatherby, of England, have adopted a plan for the impregnation of wood with a fire-proof solution, which combines with the mechanical processes above described, a chemical action involving the formation of the desired salt within the structure of the wood. After kiln-drying the lumber to be acted upon, they put it into suitable cylinders where lime and water with sulphurous acid gas are forced into the pores of the wood under considerable pressure, the theory being that when sulphurous acid is passed into lime under pressure a sulphite of lime is formed which is soluble in water, capable of crystalizing into a bi-sulphite, which is readily oxidizable and convertible into sulphate of lime or gypsum.

Most of the sulphates are to be regarded as incombustible, owing to their firmly resisting oxidation, but sulphate of lime being probably the cheapest and best non-conductor of the heat of any of them, is most used by manufacturers of fire-proof safes and for similar purposes, and hence the effort of Messrs. Moore & Weatherby to produce it. Of course their process is too expensive to be applicable to ordinary building materials; but since the kiln-drying is only requisite for driving off the turpentine and other volatile and inflammable oils, I am not sure that it may not be dispensed with in preparing many of the loose-grained and non-resinous woods used for building purposes, such as poplar, linn or basswood, cottonwood and elm, and the impregnating process applied directly to them after an ordinary seasoning. Further than this, I am not certain that by first saturating such woods with lime water, and then, after allowing them to dry out again in the open air, subjecting them to a dilute solution of sulphuric acid, the same result, namely—the production of sulphate of lime in the pores of the lumber, would not be arrived at.

Still further, since magnesia resists heat equally well with lime, and has never yet been fused or volatilized under exposure to the highest temperatures, I would suggest that timber or lumber, soaked for a sufficient length of time in a solution of sulphate of magnesia might acquire fire-proof qualities equal to those conferred by saturation with sulphate of lime.

The cheapest method which has yet been proposed for effecting this object is that of utilizing the natural functions of the tree itself for the purpose of effecting a more complete and perfect penetration by the preservative solution, the force of the ascending sap at the proper season of the year being brought into requisition to convey throughout the entire extent of the tree certain silicious and phosphatic solutions which had been introduced either at the amputated base of the trunk by means of its immersion in vessels of the preparation, or through openings made in the living, standing tree with augers or saws. Since it is well known that various coloring agents may be introduced into living trees in this way, it is altogether possible that they may also be impregnated with incombustible salts in the same manner. Within the past few days I have heard a gentleman from Texas describe a grove of standing trees in Fayette county in that state, covering some twelve or fifteen acres, which had been petrified in so perfect a condition that in some instances not only the trunks and larger branches, but even the smaller boughs, remained *in situ*. He also stated that the peculiar appearance of a stick of wood which had fallen from a wagon upon which it was being conveyed to a farm house for fuel, attracted his attention and that upon examination it proved to be partially converted into stone. I can only account for these facts by supposing that the silicification of these trees was produced by the absorption of the mineral through their roots into the pores of the wood while in a soluble condition, the subsequent evaporation of the solvent through their leaves, and the deposition of the solid salt within the substance of the wood, their final death, being possibly from this mechanical obstruction of their sap channels, and their apparent complete conversion into stone by the dropping away of the bark and woody fiber from trunk and limbs in the lapse of time. If such transformations in nature are susceptible of such explanation it seems entirely feasible to imitate them artificially.

My own experiments in this direction have been confined to a few pieces of wood found lying about, and are not as conclusive as is desirable, but at the same time tend to convince me that the means of saturating common building materials with incombustible salts at so inconsiderable a cost as to place them within the reach of most poor men desiring to build cottages for themselves and their families, are much more ready attainable than has hitherto been supposed.

IV. I deem it perfectly proper and within the legitimate scope of this article to speak of the prevention of fires by the treatment of our inflammable bedding, curtains, and even the clothing of our women and children with certain chemical preparations, which, while they do not ordinarily injure these fabrics, will prevent their readily taking fire, and thus additionally endangering our dwellings and other buildings, and even the lives of ourselves and families.

Among the chemicals whose use is suggested in rendering such articles fire-proof, are common salt, which is highly recommended as being quite effectual and less liable to injure the fabrics than many of the others, alum, borax, tungstate of soda, chloride of zinc, a mixture of tungstate of soda (25 parts), phosphate of soda (3 or 4 parts), and water (100 parts); a mixture of sulphate of ammonia and gypsum; a mixture of alum (3 parts), copperas (1 part), etc. A incombustible starch has also been suggested, composed of a mixture of phosphate of ammonia-magnesia and tungstate of soda in starch; another composed of the cystals resulting from a combination of chloride of calcium and acetate of lime mixed with starch; and still another prepared by mixing an acid solution of the chloride of zinc with starch. These starches applied to the fabrics in the ordinary way have been found very effectual protectors against fire in many instances.

For protecting the scenery of theaters, curtains and other movable hangings, a coating of water glass, with a little glycerine added to prevent its cracking and breaking off, has been highly spoken of.

V. I now come to the consideration of the prevention of fires by mechanical obstructions. These are mainly of service in hindering and preventing the spread of the flames from building to building, and consist chiefly of fire walls and metal roofs, cornices, shutters, etc. Very little can be said about the first, except that they are usually entirely too low to be of much service, my opinion being that no fire wall less than six feet high will afford any reliable and certain protection to an adjoining building. Mr. Vesey recommends in addition to the ordinary fire walls between buildings, the carrying up of walls, between blocks of buildings separated by alleys, to a considerable height above any of the buildings, for the purpose of preventing the spread of conflagrations across such alleys or narrow streets.

Metallic roofs, instead of lying directly—*i. e.*, flat upon the sheathing beneath, should rest upon it only at as remote points as their proper support requires, leaving elsewhere a space of at least two inches between them, to prevent the heat of fires passing through the metal and igniting the wood beneath. I was very much surprised a few years, since to observe how readily I could ignite a pine board, such as is ordinarily used for sheathing by burning a handful of shavings upon a piece of tin roofing placed upon it. There are several so-called composition roofs, which, in my opinion, are better protectors against fire than metal, because of their superior non-conducting properties.

Wooden cornices are the most dangerous of all fire traps, and should be prohibited in all cities.

Metalic shutters are of the greatest value when closed, but, being usually forgotten until it is too late to close them, they should be so constructed as to shut automatically at the approach of danger. One means proposed for affecting this is to provide them with springs which will force them shut upon the melting of the fusible metal fastenings with which they are to be held open; but as these springs might from long disuse lose their elasticity, or the hinges their mobility, it might be an improvement to have these shutters suspended above the windows by means of catches of fusible metal or some inflammable material. They would then drop of their own weight when the catches were melted or burned by the approaching flames, and be much more likely to assume their proper places than under the circumstances first named.

VI. Before closing this branch of the subject it may be well briefly to consider the subject of spontaneous combustion, so far as it bears upon that of the prevention of conflagrations. That certain substances under certain circumstances will ignite without the application of fire or other obvious cause, is a fact too well established to require proof, but in this connection I shall only have time to point out a few sets of circumstances under which such spontaneous combustion has occurred, and against which we should guard in our dwellings and places of business:

1. Common soft coal containing a considerable proportion of sulphuret of iron (iron pyrites), a very common impurity in all the bituminous coals of this region, is very liable to ignite spontaneously, especially when wet, which demonstrates the danger to be apprehended from the very common practice of sprinkling water upon the coal in our bins and cellars to lay the dust.

2. Matches, when kept in considerable quantities together, are liable to ignite spontaneously, owing to the inflammability and oxidability of the phosphorus contained in them.

3. Solar heat acting upon the bisulphide of carbon, used in all India rubber factories, has been known to produce it. Also it has occurred in warehouses where rubber blankets and clothing were stored. So well known is this fact, that during the late war orders were issued respecting the separate storage of such supplies.

4. Nitric or sulphuric acid thrown carelessly around upon refuse straw, wool or other litter, will frequently ignite them.

5. Cotton rags or almost any other waste saturated with oil, used in lubricating and wiping machinery, have the property of spontaneous combustion in a remarkable degree and have frequently produced serious conflagrations by taking fire in this manner.

6. Heat enough to communicate fire to adjoining inflammable substances may be generated by the slaking of lime and the rapid fermentation of damp manure, leaves, hay, etc., when piled in large heaps.

7. Freshly burned charcoal is said "to have the property of absorbing moisture, and rapidly condensing it in its pores, generating thereby so much heat that it is set on fire."

7. Several instances have been published by the *American Journal of Science*, one of our most reliable scientific periodicals, of combustion taking place in old heaps of wood ashes that had not been added to or disturbed in any way for months before.

9. It is believed by some of the best chemists that the oxidation of iron rods or pipes passing through or in contact with wood-work has resulted in spontaneous combustion and the ignition of the wood.

10. Several cases of conflagration on land and sea have been reported as caused by the concentration of the sun's rays upon inflammable substances within apartments by means of mirrors or panes of ordinary window glass. Whether these cases can be properly classed among those of spontaneous combustion may be questionable, but the knowledge that fires can be generated in this way may lead to the solution of some very mysterious cases, as well as warn us to avoid the possibility of such contingencies occurring.

11. The national board of underwriters in its late meeting at New York, reported against the use of petroleum as a lubricator on the ground that its use was dangerous and the cause of many fires.

This brings us to the end of my first division of the subject, and I will more briefly take up that of the *extinguishment* of fires or conflagrations under the following heads, viz:

EXTINGUISHMENT.

1. Extinguishment by means of ordinary water.

2. Extinguishment by means of water holding in solution gases which are non-supporters of combustion.

3. Extinguishment by means of such gases applied directly to the flames by machinery.

4. Extinguishment by means of gases or vapors generated by the heating or combustion of certain materials with which the timbers were coated or otherwise protected previously to the erection of the building.

I. Extinguishment by means of water. As it is well known that one of the constituent elements of water is highly combustible, while the other is the essential supporter of combustion, and also since it is a fact that the oxygen is separated from the hydrogen by passing the vapor of water over iron filings heated to redness at about 1500° F, the statements published by some of the Chicago and Boston paper after their great fires, that the vast amount of water thrown upon the burning buildings, by its decomposition and reduction to its gaseous elements, actually fed the flames, had a degree of plausibility about it although probably entirely incorrect.

The action of water upon fires is rather mechanical than chemical, quenching it by "physical contact with the burning body, covering it and excluding the oxygen of the air." Also, "it instantly reduces the temperature of ignited substances by vaporization. By a sudden change from a liquid to a vapor, it robs the substance of the heat necessary to keep the up the combustion and thus extinguishes it."

While owing to its extreme abundance and cheapness in most localities and at most times, water is the most useful and serviceable agent in the extinguishment of fires, yet from the damage done by it, the difficulty of applying it under all circumstances and the immense amount required to subdue an ordinary fire, it will not be surprising if, before another century elapses, it will have been superseded by other agents more effective and less objectionable.

Numerous means have been proposed for rendering its use more effective and its application more immediate and direct than at present, when we depend almost wholly upon our fire departments, and are obliged to await the arrival of the steam fire engine with its terrific floods of water, which, however well directed, seem in many instances to do more damage than would have resulted from the fire if left to itself. Much good will be accomplished by the discovery of some means of applying this agent strictly as an extinguisher, in quantities regulated to the amount of fire, in place of the present plan of applying it in volumes ten if not one hundred times more copious than is requisite, *i. e.* mathematically requisite, for the mere extinguishment of the flames.

One plan proposed for regulating the quantity and force of the water applied to fires is that of stand pipes in factories and warehouses, filled from the water-works or from tanks overhead and running from basement to roof, with appliances of hose and nozzle on each floor, and upon the roof, so that they can be brought to bear instantly at the points where they are required.

Perforated pipes placed along the ceilings of rooms, above the stages of theaters and over those localities in workshops and stores where inflammable materials are exposed and handled, may be found of the greatest use, having the advantage over engines of being always at hand and ready for use, and of applying the water in quantities appropriate to the occasion, just where needed and without unnecssary or injurious violence.

Nelson Carl proposes to carry pipes upon the roofs of buildings, to perform the double purpose of wetting them in case of fire, and thus preventing their ignition, and also of acting as conductors of lightning. Particularly would such contrivances as those described above be found extremely efficacious in very tall buildings, where the water thrown by the engines only falls upon them in spray and is converted into steam or driven away by the heated currents of air.

II. It is very apparent that if we can mix with the water used for extinguishing conflagrations some gas which is itself an extinguisher of flames, we shall increase the efficiency of the water and at the same time reduce the quantity required, thus taking at least one step in the direction indicated in the foregoing paragraph.

The principal gases which are soluble in water and also incapable of supporting combustion, are carbonic acid gas and sulphurous acid gas, both of which are readily and cheaply produced and easy of application for the desired purpose. Carbonic acid gas is soluble in water to the extent of about volume for volume, and is so well known as an extinguisher of fire that it has been used somewhat during many years for the suppression of conflagrations, both in the well known "Phillip's Fire Annihilator," a machine in which it was produced, combined with steam generated at the same time and forced upon the flames through pipes, and more recently in the Babcock and other "extinguishers," in which it is generated over cold water which it impregnates and forces rapidly out by its expansion. It is proposed to construct similar machines for the generation of carbonic acid in the basements of factories and business houses, with pipes leading to various portions of the building, by means of which this gaseous water can be speedily prepared and applied directly where it is demanded.

The *English Mechanic*, March, 1871, published a description and illustration of a fire engine on an entirely new principle, which consisted in charging the water used with carbonic acid gas and nitrogen, obtaining the carbonic acid by drawing atmospheric air through a charcoal fire and forcing it into a tank containing water. It is claimed that one cubic foot of this solution is capable of doing as much execution in extinguishing flames as fifty cubic feet of ordinary water, and in one-twentieth of the time. Whether this invention has been brought into practical use I do not know. These machines, or at least this application and use of carbonated water or vapor by *some* machine have the elements of success within them, since one gallon of water saturated with carbonic acid gas is equal in extinguishing power to ten of ordinary water, not to recapitulate the other advantages possessed.

Sulphurous acid gas is soluble to the extent of more than thirty times its volume of water, and is utterly incapable of supporting combustion. Being heavier than carbonic acid gas, as well as less energetic in its evolution, it will not act voluntarily in forcing the impregnated water through pipes, but on account of the greater amount absorbed by the same quantity of water and its equal fire quenching qualities, this defect might be profitably overcome by the use of machinery operated by other forces.

Dr. Clanney's fire extinguishing solution consists of a mixture of chloride of ammonium (sal ammoniac) and water in the proportion of five ounces of the salt to one gallon of water.

III. The next suggestion is that of applying gases and vapors which are non-supporters of combustion directly to burning substances by means of suitable machinery. In many instances this plan is applicable where neither water, nor water saturated with gases, can be used effectually, for instance under floors or within partitions in buildings, in the holds of vessels and in mines.

The first of these agencies to be considered is steam, which from its almost universal use and ready applicability to such cases, becomes a very important and effective power. Suppose a fire originates in a basement or other underground room from the furnace which is generating the very steam subsequently used for its extinction; it is not readily accessible to firemen with their hose and pipes, neither can it be reached with water from buckets; but with no loss of time whatever a jet of steam can be turned upon it, the doors of the apartment closed, and in a few minutes every corner and cranny will be filled with an overwhelming and certain extinguisher.

In the same manner steamships and steamboats may often be saved from destruction by fires originating in their holds where no amount of water short of enough to sink the vessel will reach them, while by closing the hatches and forcing in steam through pipes connected with the boilers the flames will be very soon subdued and with but little or no damage to the cargo from the extinguishing agent.

It is but a year or two since reports of a terrible fire in a coal mine in Pennsylvania reached us through the newspapers; a fire which raged irrepressibly for several months, doing vast damage. After exhausting all means within their power to quench it, unavailingly, the owners determined to try the effect of steam. The entrance was made as tight as possible and immense quantities of steam forced in, which fortunately resulted in the speedy extinction of the conflagration.

Dr. Weidenbusch, of Wiesbaden, also highly recommends steam as a fire extinguisher, and gives as an illustration of its efficiency the case of a factory in which a fire had been raging unmanageably for two and one-half hours, at which time steam was turned on, and in half an hour the fire was extinguished, although there were no means of confining the steam to any particular locality in the building.

Carbonic acid gas has also been brought into service as an extinguisher under similar circumstances, both on land and on shipboard, sometime mixed with steam, as in "Phillip's Fire Annihilator," sometimes with nitrogen and sometimes alone, but successfully in all cases where the surroundings were favorable. A noted case is that of a coal mine in England, which had been on fire for thirty years, but which was extinguished by the use of this gas within one month after its first introduction.

Sulphurous acid gas may also be rendered very useful in many such cases, and is peculiarly adapted to them from its requiring no special apparatus for its production or application. If a chimney is on fire, a half pound of sulphur or brimstone burned in the fire-place or stove, all openings in the chimney having first been made as tight as possible, will in two minutes extinguish every spark of the fire. If a fire breaks out it the hold of a sailing vessel, the use of steam is of course out of the question, and there may be no means at hand for generating and applying carbonic gas; but any one can let an iron pot filled with burning brimstone down into the hold, close the hatches and thus extinguish the fire at once. The chemical action in these cases is the absorption or abstraction of the oxygen from the atmosphere by the sulphurous acid gas generated by the burning brimstone and the consequent inability of the residue to support the combustion.

IV. The last suggestion I shall make is the extinguishment of fires by means of vapors or gases generated from the heating or burning of certain materials with which appropriate portions of buildings were coated or otherwise protected previous to their erection. It may seem paradoxical to say that a fire may be made to extinguish itself, but I am not at all certain that it is an impossible thing. Suppose, for instance, that we were to coat the joists under our floors with a mixture of flour of sulphur and glue. When the fire that we will assume to be burning reaches these joists in the confined space between the floor above and the ceiling below, the sulphur will be ignited at once, the fumes of sulphurous acid gas given off copiously, the oxygen of the air absorbed, and the fire extinguished by its own act; and so with any other gaseous non-supporter of combustion that we may conceive to be generated by heat. I have never heard of this idea being put into practice, but I see no reason why it should not succeed.

Steam has also been made to act in this very capacity by being generated, in cases of fire, from vessels of water placed between the outer and inner doors of iron safes and vaults. A remarkable case of this kind was reported in the *Journal of Applied Science* (Boston), which was in brief as follows: Vessels of water were kept not only between the outer and inner doors, but also inside the vault itself, and when the great fire occurred the result was the most perfect protection of its contents imaginable. When the fire approached this vault the heat at the outer door converted the water within into steam, which had the effect to keep the temperature of the interior so low that not only were the papers deposited within not destroyed after several hours' exposure to intense heat, but they were actually unharmed, and the wooden vessels in which the water had heen placed were intact. This suggests ideas well worth following out to a greater extent in practice than I am aware of having been done, and I do not doubt that the most important results may be secured by an intelligent and scientific series of experiments in this direction.

This concludes all I have to say to-night. There is a very small proportion of original matter in this paper, but if by gathering these facts and suggestions together from a great number and variety of sources and giving them to you in a condensed form, with some attempt at their arrangement in proper order and sequence, I have either added anything to your stores of information or furnished you something new and practical to think of, I shall have accomplished all that I had in view in preparing it.

THE ATMOSPHERE IN ITS RELATIONS TO VEGETATION.

Few of our readers need to be told that the greater part of the nutriment of plants is derived from the atmosphere. The fabled food of the chameleon is the real food of the whole vegetable world. It may indeed be asserted that all the constituents of plants, except the ash, are of atmospheric origin. Not that crops draw their supply of nitrogen directly from the air, or perhaps in all cases their entire supply of carbon; but the ammonia, nitric acid, and carbonic acid which they get from the soil are themselves derived from the atmosphere. By nitrogenous manuring we are in fact simply furnishing our crops with nitrogen previously obtained from the air under a different set conditions.

The atmosphere is, however, to a limited extent an original source of food; it merely forms part of a great circle, and is itself supplied with carbon, and partly also with nitrogen, from the exhalations of the earth. The organic parts of plants and animals are resolved by the process of decay into gases, which pass into the atmosphere and are universally diffused for the benefit of growing vegetation. The nature and amount of the various constituents of the atmosphere, and the manner in which they are assimilated by plants and the soil are clearly questions of the highest interest to the student of scientific agriculture.

The atmosphere furnishes our crops an abundant supply of carbon in the form of carbonic acid gas. At Rothamsted, England, wheat crops containing on an average about a ton of carbon to the acre were taken from the land for twenty-thee successive years, though no carbon was returned in the manure, and the experiment might have been continued for an indefinite period with similar results. This vast amount of carbon has certainly been obtained from the atmosphere.

The percentage of carbonic acid present in the air has repeatedly been made the subject of scientific investigation. Herr Schulze at the experimental station at Rostock determined the amount of carbonic acid present each day for three years. The variations observed were not great, the largest quantity of carbonic acid found being 3.44 volumes, and the smallest quantity 2.25 volumes in 10,000 volumes of air, the mean of all his results being 2.92 volumes of carbonic acid in 10,000 of air. This proportion —3 to 4 volumes in 10,000—is the quantity which has most usually been obtained. If we take 3.5 as a mean number, then 1 lb. of carbon will be contained in about 3500 cubic yards of air of the ordinary temperature and pressure. As we have just seen that a good wheat crop is capable of removing one ton of carbon from the air in the course of a few months, it is evident that the constant renewal of the air by winds perfectly compensates for the small fraction of carbon it contains.

The amount of carbonic acid in the air is rather less at the surface of the sea than on land. It is at sea greater in the day than in the night, but on land the reverse is the case, especially in the neighborhood of vegetation, as recently shown by Truchot. Plants continue to produce carbonic acid in the night as in the day, but in daylight the decomposition of carbonic acid is so great that none is evolved, while in the night evolution takes place. According to Truchot the proportion of carbonic acid in the air diminishes with an increase of altitude, and is less on mountains than in the valleys. This is probably the case, as the carbonic acid of the air is supplied by exhalations from the earth.

Truchot has also made some experiments on the influence of altitude on the amount of ammonia present in the atmosphere. The greatest altitude employed for observation was the summit of the Pic de Sancy, about 6000 feet above the sea. There appeared to be a distinct increase in the amount of ammonia at considerable altitudes, and the quantity was apparently greater in foggy than in clear weather. The largest quantity of ammonia found was 1 lb. in about 107,289 cubic yards, and the smallest amount 1 lb. in 640,262 cubic yards of air.

The ammonia in the air is probably derived entirely from exhalations from the earth, though Schlosing believes that a portion of it emanates from the ocean. The nitrates washed into the sea in vast quantities by rivers are, in his opinion, converted first into food for marine plants, and on the death of these plants, or of the animals feeding on them, a part of the nitrogen is returned to the air as ammonia.

Of nitrous acid the air has undoubtedly an original source in the electric discharges, silent or otherwise, which are continually occurring. It is well known that nitric acid is produced whenever an electric spark passes through the air, and it was supposed that the ozone produced by the spark was capable of oxidizing nitrogen into nitric acid. This property of ozone if established, was clearly of great importance, as ozone is apparently given off in small quantities by plants in sunshine, and vegetation would thus itself afford a supply of combined nitrogen. But according to Carius, who has thoroughly investigated the subject, ozone is quite incapable of oxidizing free nitrogen; it will, however, oxidize ammonia into nitrites and nitrates, and doubtless converts into nitric the nitrous acid produced by electric action.

Another oxidizing substance present in the atmosphere is peroxide of hydrogen. The conditions under which it occurs have been studied to some extent in Germany, but the results as yet obtained are not very definite.

The total amout of combined nitrogen which is brought to the soil annually in the form of rain was determined some years ago at Rothamsted. Bretschneider more recently has given the results of six years' observations at the experimental station of Ida-Marienhutte where the average rainfall is about 22.5 inches. The quantity of combined nitrogen (ammonia and nitric and nitrous acid) contained in the rain, varied during the six years from 6.32 lbs. to 12.61 lbs. per English acre, the average being 9.94 lbs. As we remarked last month, the fertilizing influence of snow is due to the nitrogen compounds which it brings down from the atmosphere. According to the experiments made four years ago by Vogel at Munich (briefly referred to in the *Journal* for May, 1873), freshly fallen snow furnished water containing .003 gramme of ammonia to the litre; and snow that had lain twenty-fours on a field which had been manured the previous autumn was found, when melted, to contain .012 gramme to the litre. The whole amount brought down by rain and snow must constitute no insignificant fraction of the nitrogenous food of plants.—*Boston Journal of Chemistry.*

TECHNOLOGY.

PROPERTIES OF IRON AND STEEL CONSTRUCTIONS.*

EXCESS OF ELASTIC LIMIT.

The limit of elasticity is generally defined as that stress per square unit beyond which permanent changes of form occur, while under less stresses the body returns to its former condition. Reference is made, not to sudden changes in stress and shocks, but to gradually increasing strains. But the definition is theoretically worthless, for a limit so definite is not probable, and much less is it proven. On the contrary, Hodgkinson and Clark have observed that there are permanent changes of form under very small loads. At present we must be content with defining this limit with Fairbairn, as that stress below which the changes in form are approximately proportional to the forces, while above this they increase much more rapidly. The words "approximately" and "much" are not so indeterminate as might be supposed, for in the experiments of Bauschinger, the passage beyond the limit of elasticity could be determined very precisely; as for example in tension; "for with the same increase of load a disproportionately great elongation occurred at once, the maximum of which was in every case reached after some time." This sudden elongation must be credited to permanent changes of form; further elongations until near the breaking limit remain proportional to the stresses, and the modulus of elasticity is always found to be independent of the latter. In the first definition the changes of form which are permanent from Bauschinger's point of view are neglected. All experiments, up the present time, have shown that when the elastic limit is passed, the tensile resistance is considerably increased, while ductility and tenacity diminish; the metal becoming brittle, and having little power of resistance to shock. In experiments at the Woolwich Arsenal, an iron rod, four times ruptured by pull, gave the successive values of

*From Weyrauch's Work on the Strength and Calculation of Dimensions of Iron and Steel Constructions. D. Van Nostrand, New York.

t: 3,520, 3,803, 3,978, 4,186; Bauschinger tore apart a piece of iron seven times, and the resistance increased from 3,200 to 4,400.

Paget found that iron chains after stretching bore a greater dead weight but had less resistance to shock. Fairbairn thought all these phenomena could be explained by the hypothesis that the resistance of all the parts was not at first called into action, but, like ropes, they became gradually strained in common under sufficient load. With this accords the fact that Bauschinger observed that increase of resistance, especially in rolled iron, was notably regular when the stress was in the direction of the fibres. The analogy holds further; for a rope, when tense is more easily broken by shock. And this explains why a rod under sudden increase of stress breaks more readily than in case of gradually increasing pull.

When the limit of elasticity is passed, this limit is again raised. Tresca, in tests of rails, succeeded in pushing the limit of elasticity to near the limit of rupture, so that it was less by about one-tenth. The practice hitherto has been to assume as permissible stress (b) a fraction of the elastic limit. In this case b increases with the number of loads. But the material becomes more brittle, and less resistant to shock, and local passages beyond elastic limits are not excluded. So that we need not assent to the often-advocated opinion that a test of material beyond the elastic limit would be of advantage. It is worth mention that the increase of resistance with the passage beyond each limit cannot go on indefinitely; but a diminution must occur at some time, unless we assume that with very gradual increase of stresses and longer intervals, the original resistance becomes greater than the initial ultimate strength.

Now, if passage beyond the elastic limit can work unfavorably, it should not be permitted. But it is enough to know that, according to the numerous experiments of Styffe and others upon all sorts of iron and steel, the ratio of elastic limit to ultimate strength generally lies between $\frac{1}{1.4}$ and $\frac{1}{1.8}$, and under the most favorable circumstances seldom reaches $\frac{1}{2}$.

Wertheim and Styffe have attempted to establish more precise definitions of the elastic limit, but as they are not better, either theoretically or practically, than others, it would be superfluous to consider them. It is since the time of Hodgkinson and Clard that an empirical importance has attached to this limit; and it is still very narrow in its scope, because the limit, as above defined, is of no avail in case of sudden change of strain and of repeated stresses.

Vicat made experiments to determine the effect of lapse of time upon a dead load. He kept wires loaded up to three-fourths the tensile resistance, during thirty-three months. The one with heaviest load broke. Vicat inferred from this, and because the extension seemed to be proportional to the time, that every load beyond the elastic limit would, after lapse of time, cause rupture. Considering that very small loads cause permanent changes in form, it would be more correct to infer that any load, if given time enough, will cause rupture. Fairbairn thought he could prove this by tests on cast-iron girders. But we do not find that the results of his experiments warrant his conclusion. But the fact that under stress beyond the elastic limit the ultimate strength increases, leads to the the conclusion that security against dead-load increases with time. But if it is objected that a decrease may follow an increase of ultimate strength, it must be admitted, in view of all that has been said, that the influence of duration of dead-load has not been clearly determined. That each load requires a certain time to cause its correspondent permanent change has been known since the time of Hodgkinson and Wertheim, and also accords with Fairbairn's comparison with ropes; and, again, it has been observed by Bauschinger. This also holds true for further changes in form; and if a rod stretched again when released, does not at once return to its previous condition, a so-called secondary action takes place. This was observed in Kupffer's experiments. Thurston thinks that in this he has discovered a new phenomenon; that ultimate strength and elastic limit increase after a strain greater than the latter, continued for twenty-four hours. But there is nothing new in it. That the tensile resistance of iron and steel is greater under the action of an electric current, and that the ductility is effected, now one way, now another, by dipping the metal in acid, seem to be shown by detached experiments, but this needs confirmation.

INFLUENCE OF TEMPERATURE.

The influence of different temperatures upon the strength of steel and iron is not satisfactorily explained. With respect to ultimate resistance only, because of numerous experiments, has their been a growing accord of views. For most kinds of metal, especially for iron, the ultimate strength appears to increase with the decrease of temperature below zero, but also to reach a maximum at a little above 100° C. Within a certain interval near 16° the resistance is quite constant; the beginning and the rapidity of the increase and the position of the maximum are dependent upon the conditions already considered.

Fairbairn, in tension experiments with bar iron, found, in one case, the resistance at 0° equal to, in another, 1 per cent. higher than at 60°. Thurston found in torsion experiments a decided increase of strength to — 12°. Spence, in experiments in bending cast-iron, found at — 18°, a strength greater by about 3.5 per cent. than at + 15°. At higher temperatures, Fairbairn found for bolt iron the maximum of ultimate tensile strength at 163° 41 per cent. greater than at 18°; later experiments with bar iron put the maximum at 213°. A commission of the Franklin Institute, at Philadelphia, found the maximum strength 15 per cent. greater than its ordinary value at about 288°. Styffe has published the results of numerous experiments. See his Table VII.

Beyond the maximum the ultimate resistance decreases at first slowly, but very rapidly at red-heat. In this respect, too, the different kinds of metal behave very differently, and the diminution may possibly be the quicker and more rapid the lower the temperature of the metal when under mechanical treatment. Tensile resistance Fairbairn found to diminish from 202°, where it was about the same as at ordinary temperature, a low red heat, by about 17 per cent.; up to ordinary red heat, by about 34 per cent. Experiments at the Franklin Institute found the ultimate tensile resistance, at 575° lowered by 0.66, and at 700° by 0.33 from the ordinary value. Bauschinger observed the strength of puddled plate, transverse to the direction of rolling, to be at red heat 780 kil. (2,700 ordinary), and of rolled iron along the fibres, 50 (4,430 ordinary).

These results are of importance with respect to constructions exposed to fire. Kirchweiger, of Hanover, regards the diminution of tensile strength by heating as the cause of boiler explosions; attempting to prove at the same time that a boiler filled with water may become red-hot. Bauschinger thinks it possible that the continual variations and differences of temperature of the outer and inner surfaces may diminish the cohesion of the laminæ of the plate; the inner laminæ bearing a disproportionate share of the strain, and the shearing resistance being lessened.

A frequent theme of discussion is the influence of cold upon resistance to sudden changes of stress—shocks in particular. It cannot be denied that more axles and wheels break in winter than in summer. Styffe maintains that rupture is often due to the fact that the parts are held fast, and, therefore, cannot yield to the contracting influence of the cold: again, for tires, axles and rails, the effect of shocks is increased by the diminished elasticity of the ground.

Sandberg, in an appendix to the English translation of Styffe's work, maintains that these are not the principal causes of breaking. He laid iron rails upon granite supports which lay upon granite rocks, so that the elasticity of the foundations might be the same in any season. The two halves of these rails were tested by blows with a 380 kil. ball at — 12° in winter, and + 29° in summer; and it was found that at — 12° the rail could withstand only $\frac{11}{39}$ of what it could at + 29°. This showed, at least, that there are some kinds of iron that are weakened by frost. Styffe had tested only under dead loads, and in this respect his results were trustworthy.

Sandberg also found this peculiar result: that Aberdare rails, which bore in summer 20 per cent. more strain than those from Creusot, in winter had 30 per cent. less strength. This could be explained on the hypothesis of a difference in constitution which affected the strength unequally. Fairbairn had already shown the unfavorable effect of phosphorus and sulphur at low temperature; and Sandberg thought it possible that different results would have been reached had the metal been free from phosphorus.

Unfortunately the chemical constitution of the rails was not determined; but it seems likely, that phosphorus, which always diminishes resistance to shock, may operate more actively at a low temperature. Its effect also increases under high heat. Styffe found that the grain of a screw-bolt of phosphor-iron was so affected, that a single blow of the hammer broke it.

Steel, with increasing mixture of phosphorus, loses its capacity to undergo repeated heating without losing its peculiar properties.

In the year 1871, Joule, Fairbairn, Spence and Brockbank contributed to the Manchester Literary and Scientific Society four papers upon the influence of cold upon iron and steel. All agreed that resistance to dead load was not diminished by cold, but considerably increased. Brockbank held it certain that cold diminishes resistance to shock; this, Joule and Fairbairn did not admit. All referred to experiments. No one will question the exactness of Joule's tests; but the test-pieces were wires, needles and nails, so that the results may not hold for larger pieces; while Fairbairn and Spence tested only under dead load. A series of observations by Brockbank confirm the results obtained by Sandberg. Rails were tested with blows; and in frosty weather they had far less strength than at ordinary temperature: a hollow cast-iron core-rod, about which a cylinder had been cast, cooled down to — $7\frac{1}{2}°$, broke square and smooth, leaving a brittle-looking surface, while the pieces were made stiff and sound again by heating. A rod of round iron of best quality, of 38 mm. diameter, which lay a week exposed to frost and was covered with ice, broke at $4\frac{1}{2}°$ under a single blow of a hammer weighing 5.4 kil.

All authorities admit the increase of resistance to tension under great cold, though they deny that there is a diminution of power to resist shocks. This is bad reasoning. It is certain that resistance to dead load is somewhat increased by frost; and besides this, according to Styffe, the elastic limit; just as is the case under hammering, rolling, hardening, etc.; but as with all the latter, resistance to shock increases, there seems to be no reason for a contrary judgment in the first case. Styffe has proved that iron becomes stiffer with decrease of temperature; agreeing with Sandberg.

Thurston concludes from results of his experiments that phosphorus and other substances, inducing cold brittleness, may impair resistance to shock at low temperatures, which seldom occur; and that in other cases resistance to dead load, as well as to shock, is increased by cold. This would be novel, but it must first be proven. Thurston's test-machine is well adapted to the lecture-room, being convenient and cheap; but it is not suitable for scientific experiments requiring results numerically exact. The velocity, an important element, is not regulated; the methods of measurement are much too primitive to answer to small differences due to temperature; and it is not to be taken for granted that torsion-tests are best suited to determine the properties of resistance of fibrous and laminated metals.

In a report of the Massachusetts Railroad Commissioners (1874) mentioned by Thurston, it is said, that "cold does not make iron and steel brittle and unsuitable for mechanical purposes, and that it is not the invariable rule that the most breakings occur on the coldest days." The membership of the Commission is not given, nor is it certain what kinds of metal were under consideration. Did it contain a large percentage of phosphorus? Were the rails iron or steel? It has been found in Northern climates

—Canada, Sweden, and Russia—that a low steel, with $\frac{1}{3}$ to $\frac{1}{2}$ per cent. phosphorus, was affected by cold much less than iron. According to Styffe, there is no authentic case in which good steel contained more than 0.04 per cent. of phosphorus; though in one English iron rail there was 0.25 per cent., and in Dudley iron 0.35.

We draw the following conclusions from all the data at hand: (*a.*) Iron and steel, which are entirely or nearly free from all foreign materials, have neither their resistance to dead load notably increased by cold, nor their resistance to shock diminished. (*b.*) Certain elements, not exactly determined, but phosphorus certainly, very much diminish resistance to shock and sudden change of stress. (*c.*) The question cannot be definitely settled until the chemical constitution is determined. (*d.*) Statistics of results in warm and cold latitudes, in summer and winter, after long frost, on days of sudden intensity of cold, are required.

The above has reference to the immediate influence of temperature. In regard to the effect of repeated changes of temperature, Wohler conjectures that frequent vibrations of molecules caused by heat, have the same effect in destroying cohesion as vibrations caused by external forces. Data from observation have not been obtained. Spangenberg, after examination of the fracture surface, did not adopt this hypothesis. Bauschinger, after testing boiler-iron, thought it possible that the strength of the plate was weakened by long action of the fire. But this decides nothing as to the effect of repeated influences. If Wohler's hypothesis is correct, we should recognize in change of temperature a cause of destruction, not only of metals, but also of all other solid bodies. And safety co-efficients would be of no avail, for if we should make one beam twice as large as another, each half of the first would be as much affected as the whole of the second. In any case, bridges and buildings, which are subjected to only slight variations in temperature, will certainly be more likely to fail from other causes.

PAVING COMPOSITIONS.

L. W. Sinsabaugh, of the United States Patent Office, has compiled a most excellent digest of all patents granted for paving and roofing compositions up to January 1, 1876.

Scarce a week passes that inquiry is not made of us concerning some new method of forming asphalt paving composition. For information of such, we will republish the English and American patents granted for such compounds for 1874-5.

Richardson, James P.; March 30, 1875; No. 161,550. Application filed August 1, 1874.—Five pounds copal-gum, 20 pounds asphaltum, and 40 gallons coal-tar are thoroughly mixed and commingled by the aid of heat, and when properly combined, broken stone, ashes, or equivalent material is added to form a plastic mass. This is applied to the road while still hot, and rolled heavily until perfectly solid.

Claim: The composition of copal-gum, asphaltum, and coal-tar, alone mixed with crushed stone, ashes, or equivalent material, for the formation of pavements, carriage-ways, and the like, as herein described.

Stow, Henry M.; October 11, 1875; No. 168,805; application filed July 20, 1875.—Hard pressed bricks (previously saturated with a composition of 90 parts coal-tar pitch, 4 parts kerosene or dead-oil, 4 parts unslaked lime, and two parts sulphur), are laid in such a manner, either on their sides, edges, or ends, as to leave interstices. The interstices are filled and the entire surface covered with broken stone, gravel, or sand, well saturated with pitch, and heavily rolled. On this foundation is spread a composition of 85 parts coal-tar pitch, 3 parts dead oil or coal-tar, 8 parts unslaked lime, 4 parts sulphur, and sufficient clean sharp sand to bring it to consistency or mortar.

Claim: 1. A pavement composed of hard-burned bricks placed on an earth foundation, with intervening spaces, cells, or recesses for the top dressing to bed into and thereby firmly unite with the brick substructure, and so prevent peeling off, as described and represented.

2. In a pavement having a hard brick foundation, laid with intervening spaces, cells, or recesses, a concrete top-dressing composed of coal-tar pitch, dead-oil, or coal-tar, unslaked lime, sulphur, and broken stone, gravel, or sand, prepared and applied substantially as herein described and represented. [Drawing.]

Thormann, J. H. and Brumshagen, F.; August 10, 1875; No. 166,486; application filed July 22, 1875.—This invention relates to that class of concrete pavements or floors which are laid in sections in imitation of stone flagging, and consists in cementing the sections together with white lead.

Claim: A pavement or floor composed of concrete flags or blocks, separated by interposed layers of white lead, substantially as and for the purpose specified. [Drawing.]

Tucker, J. C.; November 16, 1875; No. 170,132; application filed June 11, 1875.—Artificial stone. This invention relates to certain improvements on that class of artificial stones described in his patent No. 128,680 and reissue No. 5,043.

The present improvement consists in a compound of 70 parts iron-slag, 20 parts asphaltum or other bituminous material, and 10 parts animal, vegetable, or mineral fibre.

Claim: An artificial stone produced by combining slag with asphaltum or other bituminous material while in a heated state, and with an animal, vegetable, or mineral fibrous material, in sheet or block, with or without pressure, substantially as set forth.

Von Versen, F. and Bickel, John; July 20, 1875; No. 165,896; application filed June 24, 1875.—Paving blocks are made of a composition of 25 parts protoxide of iron, 50 parts ferruginous silica, and 25 parts pulverized quartz. The compound is properly tempered with water, and molded into blocks having longitudinal grooves on their edges to receive the cement for uniting them. The blocks are burned in a kiln until their surfaces are vitrified.

Claim: A paving block or tile composed of the ingredients hereinbefore stated, and burned until a vitreous surface is produced, with or without the grooves *a* and channels *b* or either of them.—*Mines, Metals and Manufactures.*

METEOROLOGY.

THE CAUSE OF MIRAGE.

Mirage (pronounced Me-razhe) is derived from the Latin *miror*, a looking glass. It is the optical phenomenon by which objects are seen as if reflected from a mirror or appear suspended in the air. Sometimes the figures of objects seen suspended are inverted. The facts plainly indicate that in some way the atmosphere, when this phenomenon occurs, is in such a physical condition that it acts like a mirror. What is the cause that produces at times this physical condition in the atmosphere?

I have compared the dates of several hundred cases of this phenomenon with the local condition of the atmosphere where the case has occurred, and find that fully ninety per cent. of the phenomena occur under a high barometer, and the remainder, not exceeding ten per cent., under a low barometer. Not only is this the case, but the phenomenon invariably occurs when there is a calm, or at most only so light a breeze as to be scarcely perceptible. The calms indicate that the phenomenon occurs at or near the centres of both high and low barometers. An inspection of the daily maps of the Signal Service shows, that either a high or low barometer is central, or nearly so, over the locality where the phenomenon occurs. These facts at once point out the direction in which we must look for the explanation of the phenomena.

Those who have carefully read what I have written in elucidation of the fundamental principles of meteorology, know that I hold high and low barometers are electric phenomena. In short, I hold that every centre of both high and low barometers is a highly charged electric point on the surface of the earth; the point negatively electrified under the high barometer by induction acting upon and by attraction pulling down the positively electrified air in the clear sky—characteristic of high barometers—and the electric point in the centre of low barometer, being acted upon by induction from the overhanging positively electrified cloud—for a cloudy sky characterizes the low barometer—sends up negatively electrified air and vapor to the positive cloud. Hence in both instances high electric tension, or as it is called, electric potentiality, prevails on every area of the earth's surface covered centrally by either a high or low barometer. A careful consideration of these facts at once suggests whether the electric condition of the air in contact with and immediately over the intense electric point, is not the cause both of the reflection of light where the objects are mirrored on the sky, and of the aberration of light where objects below the horizon loom up so as to seem above it.

The mutual correlation, equivalence, and identity of the physical forces, are well established, and with well-informed scientists are admitted facts. But our knowledge as regards the behavior towards each other and the action between these forces is yet imperfect and in its infancy; but as far as experiments have been made and observation has extended, the results show that there is a mutual action and reaction between them; and that one force will cause the influence of another to deviate from a straight line, and forces it, measurably at least. to avoid collision between them.

For illustration I might refer to the action of crystals as regard light. Crystals unquestionably are formed by electric action, the atoms of which they are composed arranging themselves under the influence of opposite polar forces. It is found that light is more readily and with less aberration transmitted at right angles to the axis of crystalization than along this axis. When a crystal is suspended over a helix carrying an electric current, it will place itself with the axis of crystalization longitudinally to the helix, that is, across the coils of the helix, pointing in the direction that the helix throws its magnetic force. If it be suspended over a straight wire carrying such a current, it will place itself equatorially across the current, that is, at right angles to it, again pointing in the direction the current throws its magnetic force. These facts show that the crystal is affected by polar forces exerting influences in opposite directions, and that light is less obstructed and less interfered with when it is transmitted at right angles to the line along which these forces act, than along with or parallel to that line.

Herr Wiedmann's experiments show that crystals have greater conductibility of electricity perpendicular to their axes than along those axes. Electric currents always develop Magnetism at right angles to the course of the current. For illustration: suppose we draw figures of two circles, and arrows along the line of the first circle showing that an electric current flows along the circumference of the circle in the same direction that we see the hands of a watch move when its face is turned towards us. Arrows are likewise drawn around the second circle so as to show that the current flows in the direction opposite to the movement of the hands of a watch when its face is turned towards us. The electric current circulating in the first figure will develop *boreal* or northern magnetism on the side we are standing; and that of the second circle *austral* or southern magnetism on the same side. In other words, when the progress of a circulating current as we see it, is *direct*, that is, with the hands of a watch, then we are said to be standing on its front, and a current always develops boreal magnetism in its front. When the progress of an electric current is *retrograde*, that is, contrary to the hands of a watch, then we are standing in its rear, and an electric current always developes austral magnetism in its rear. Hence the current of our first circle develops boreal magnetism in its front, which is turned toward us, and austral magnetism in its rear, which is turned away from us; and the second figure develops boreal magnetism in its front, which is turned away from us, and austral magnetism in its rear, which is turned towards us. To fix these laws indelibly upon the mind, we have only to remember that electric currents are always flowing from east to west through the *strata* of the earth. Suppose we could see these currents, and that we stood off in space opposite to the north pole of the earth, the flow of the currents would be seen to be direct: hence boreal magnetism is developed at the north pole. At a similar position opposite the south pole, the movements of the currents would be seen to be retrograde: hence austral magnetism is developed at the south pole.

Suppose now that we join our two circles with first figure on top, they will form the figure 8. If we now commence on the left side of the lower loop of the figure 8, and trace the current through and around the entire figure, we find that the current now is continuous; but its course is direct in the upper loop and retrograde in the lower. If these joint figures represent two atoms, then we have the north pole of one atom superimposed over the south pole of the other on the side facing us, and the same on the reversed side, or the side turned away from us.

This forms a magnetic equilibrium the same as two magnetic needles similarly arranged form what is called an astatic needle, a needle that is not affected by the earth's magnetism. This is supposed to be the principle upon which the atoms arrange themselves in the act of crystalization along a line called the axis of the crystal. Hence the season is evident why an electric current will more readily pass through the crystal at right angles to the axis than along said axis.

Magnetism is not a primitive physical force, but is an attribute of electricity. It is an electric effect, and is caused in the following manner. If we subject an astatic needle to the influence of a powerful electric current, then the astatic condition is broken up and the ends of the different needles separate and swing around so that the north poles are together and the south poles also. Or if not, then the astatic condition is destroyed, for the needle which has its north pole on the side of a helical current where austral magnetism is generated, will have its boreal magnetism obliterated and replaced by austral, and *vice versa*. In fact it is supposed that the whole is affected by an atomic change of position, that is, the north poles of the atoms swing around so that they all face one way, and consequently all south poles of the atoms face in the opposite direction.

Soft iron when placed within the coils of a helix becomes instantly an electro-magnet, and as instantly loses all traces of magnetism when the current is broken. It is supposed that in soft iron the atoms swing easily and hence the instant conversion and reversion that is observed. In steel, which is hard iron, because carbonized and hence compound, the atoms swing only gradually and that by coercion; hence though steel takes on the magnetic influence slowly, yet the magnetism persists after the current ceases to flow, and the steel bar or needle, as may be, remains a permanent magnet.

A ray of polarized light passing through a transparent medium, is deflected to the right or left of its plane of polarization according as the transparent medium is under the influence of the north or south pole of a magnet. A polarized heat ray passing through a crystal of rock salt is deflected from its plane as by the action of the poles of a magnet.

These cases, we think, justify the inference that light will be similarly acted upon by any transparent electrified medium. Magnetism is an effect of electricity, and certainly it is entirely logical to infer that if electricity causes this deviation of light mediately by the indirect action of magnetism, then it can and does cause it immediately by direct action. Air is a transparent, or rather translucent medium. That in calm air or nearly so, under a high barometer, the atoms of oxygen and nitrogen have greatest positive electric tension; and greatest negative electric tension under a low barometer, are facts well established by observation. Deviation of the rays of light from a straight line, causes the phenomenon of mirage; since experiment proves that electric *media* cause such deviation, hence it must be inferred that the abnormal electric tension of the atmosphere—characteristic of the centres both of high and low barometers—causes the deviation of light that produces the phenomenon of mirage, that is, causing objects to appear above the horizon when they are actually below it.

At other times the atmosphere acts like a mirror, giving rise to two species of phenomena: (1) where objects below the atmosphere and beyond the stratum of atmosphere reflecting them are represented as inverted; and (2) where the objects on the same side as the observer are reflected back as if the atmosphere were a mirror.

Fremont, in his journals of his expeditions in the Rocky Mountains, gives an example of this reflection. One day, while in the Utah Basin, they observed a party approaching some miles distant, moving as though they designed to cut off Fremont and his party. The latter halted, and instantly the phantom party halted also. Fremont now detailed one of his party to interview the opposite party, to ascertain what they wanted. Instantly one of the opposite party also came forward to meet the envoy. Then the true state of the case was first perceived, that is, that the suspicious party with such sinister movements was no other than their own images reflected as in a mirror.

On the 29th of March, 1874, I saw a similar phenomenon at Boulder City, Colorado. The day before a heavy snow storm had prevailed, and snow to the depth of about ten inches had fallen. But on the day in question the air was calm and the sky serene, with a brilliant and warm sun. I was to dine with the Mayor, Mr. Ephraim Pound, but in making calls upon friends noon found me at the base of the mountains; and since Mr. Pound lived in the eastern part of the city, I faced about towards the east, but with bewilderment and astonishment I there saw not only the "foot hills" of the mountains, but mountain ridge rising after and above mountain ridge, until finally the whole was surmounted by the Snowy Range. At first the image seemed near, rising from the eastern limits of the town, but it soon receded and became fainter. When I reached Mr. Pound's, it was, apparently eastward of that remarkable basaltic bute called Valmont. I called the household to come and look at it, but it rapidly vanished, appearing towards the last like a line of faint cumulus clouds stretched along the margin of the eastern horizon.

On several occasions, while in deep mountain canyons, I saw portions of the Snowy Range, with all the intervening mountains mirrored on the eastern sky, when the canyon walls cut off all view of mountains at the point where I was.—*American Meteorologist*, March, 1877.

ICE AT THE BOTTOM OF THE SEA.

Professor Hind, of St. John, N. B., in a recent paper addressed to his government gives a description of the remarkable effect of "anchor ice" on the coast of New Foundland. It is thus summarized by a correspondent of the Toronto *Globe*: Anchor ice is a form of ice which occurs both in fresh and sea water, and is known to the Germans under the name of "Grundeis," to the French Canadians under that of "frazoo," and to the old sedentary seal hunters under the name of "lolly." Anchor ice forms in rapid rivers, and has not unfrequently been described. It is, however, on the borders of the Arctic current, where sea water rapidly cools in the fall of the year, along our coasts that anchor ice manifests itself in a peculiar manner.

During the first cold snap, at the beginning of winter, say towards the middle of November and early in December, the sedentary sealers often had small spiculæ, or needles of ice, formed on the corks of their seal nets, which are set in eight, ten, and sometimes fifteen fathoms of water. If the seal nets are not soon taken up when the corks near the bottom begin to show ice needles forming about them they are liable to be lost. The spiculæ accumulate very rapidly, and, being lighter than water, they will enable the corks to raise the whole net to the surface, and if the anchors are not "frozen to the bottom of the sea" the net is liable to be drifted away by the tides. It sometimes happens that the anchors of seal nets are frozen to the bottom, and when forcibly detached they bring up masses of frozen sand, and this from a depth of fifty and sometimes seventy feet below the bottom of the sea; in other words, the "bottom of the sea is frozen."

This remarkable phenomena was inexplicable till Despretz showed that sea water in cooling does not follow the ordinary law which governs fresh water when it cools from forty degrees to the freezing point. But sea water increases in density regularly as it cools, hence the coldest water is always at the bottom. Sea water freezes at twenty-seven degrees Fahrenheit, or five below the freezing point of water; hence, as the coastal waters cool in the fall on the Labrador and northeast Newfoundland shores the bottom layer of water acquires, during a cold snap, a temperature of five degrees below the freezing point of fresh water, and from every rough surface, such as stones, bits of sand, seal net corks, seal nets themselves, minute spiculæ of ice form, first at and near the bottom, where the water is coldest, and these very rapidly accumulate, break off and rise to the surface, forming the "lolly." When sealers see "lolly" forming they at once take up their seal nets; and it often happens on the Labrador coast that seals taken in nets sunk fifty feet below the surface are found frozen solid when brought to the surface.—*Journal of Applied Science.*

METEOROLOGY AND SUN SPOTS.—In a report by a committee of the British Association we find the following: "Recent investigations have increased the probability of a physical connection between the condition of the sun's surface and the meteorology and magnetism of our globe.

"In the first place, we have the observations of Sir E. Sabine, which seem to indicate a connection between sun-spots and magnetic disturbances, inasmuch as both phenomena are periodical, and have their maxima and minima at the same times.

"On the other hand, the researches of Messrs. Baxendell and Meldrum appear to indicate a relation between the wind-currents of the earth and its magnetism, and also between the earth's wind-currents and the state of the sun's surface.

"In the last place, the researches of Messrs. De la Rue, Stewart, and Loewy, appear to indicate a connection between the behavior of sun-spots and the position of the more prominent planets of our system. Whatever be the probability of the conclusions derived from these various researches, they at least show the wisdom of studying together in the future these various branches of science."—*Scribner.*

MEDICAL.

MEDICAL PROFESSION IN MODERN THOUGHT.

You will not be long in practice before you will have many occasions to take notice how little people ever think of the power which they have over their own destiny and over the destiny of those who spring from them—how amazingly reckless they show themselves in that respect. They have continually before their eyes the fact that by care and attention the most important modifications may be produced in the constitution and character of the animals over which they have dominion—that by selective breeding an animal may almost be transformed in the course of generations; they perceive the striking contrast between the low savage with whom they shrink almost from confessing kinship and the best specimens of civilized culture, and know well that such as he is now, such were their ancestors at one time; they may easily, if they will, discover examples which show that by ill living peoples may degenerate until they revert to a degraded state of barbarism, disclosing their former greatness only in the magnitude of their moral ruins; and yet, seeing these things, they never seriously take account of them, and apply to themselves the lessons which lie on the surface. They behave in relation to the occult laws which govern human evolution very much as primeval savages behaved in relation to the laws of physical nature of which they were entirely ignorant—are content with superstitions where they should strive to get understanding, and put up prayers where they should exert intelligent will. They act altogether as if the responsibility for human progress upon earth belonged entirely to higher powers, and not at all to themselves. How much keener sense of responsibility and stronger sentiment of duty they would have if they only conceived vividly the eternity of action, good or ill; if they realized that under the reign of law on earth sin and error are inexorably avenged, as virtue is vindicated, in its consequences; if they could be brought to feel heartily that they are actually determining by their conduct in their generation what shall be predetermined in the constitution of the generation after them! For assuredly the circumstances of one generation make much of the fate of the next.

In the department of medical practice in which my work mainly lies I have this amazing recklessness strongly impressed upon me; for it occurs to me, from time to time, to be consulted about the propriety of marriage by persons who have themselves suffered from insanity, or whose families are strongly tainted with insanity. You will not be surprised to hear, I dare say, that I don't think any one who consults me under such circumstances ever takes my advice except when it happens to accord with his inclination. The anxious inquirer comes to get, if he can, the opinion which he wishes for, and, if he does not get that, he goes away sorrowful, and does just what his feelings prompt—that is gets married when he has fallen in love, persuading himself that Nature will somehow make an exception to inexorable law in his favor, or that his love is sufficient justification of a union in scorn of consequences. Certainly, I have never met with so extreme a case as I chanced to light upon in a book a short time ago. "I actually know a man," says the author, "who is so deeply interested in the doctrine of crossing that every hour of his life is devoted to the improvement of a race of bantam fowls and curious pigeons, and who yet married a mad woman, whom he confines in a garret, and by whom he has insane progeny." But I have met with many instances which prove how little people are disposed to look beyond their immediate gratification in the matter. If it were put to two persons passionately in love with one another that they would have children, one of whom would certainly die prematurely of consumption, another become insane, and a third, perhaps, commit suicide, or end his days in workhouse or jail, I am afraid that in three cases out of four they would not practise self-denial and prevent so great calamities, but self-gratification, and vaguely trust "the universal plan will all protect!"

Those who pay no regard in marriage to the evils which they bring upon their children, or in their lives to the sins by which the curse of a bad inheritance is visited upon them, may plead in excuse or extenuation of themselves the vagueness and uncertainty of medical knowledge of the laws of hereditary action. We are unable to give them exact and positive information when they apply to us, and they naturally shelter themselves under the uncertainty. Were our knowledge exact, as we hope it will some day be, we could foretell the result with positive certainty in each case, and so speak with more weight of authority. It is one of the first and most pressing tasks of medical inquiry to search and find out the laws of heredity, mental and bodily, in health and in disease, and, having discovered exactly what they are, to apply the knowledge purposely to the improvement of the race—that is, to prevent its retrogression and to promote its progress through the ages. I see no reason to doubt that by discovery of these laws and intelligent practical use of our discoveries we might in the fullness of time produce, if not a higher species of beings than we are, a race of beings, at any rate, as superior to us as we are superior to our primeval ancestors; the imagination of men seems, indeed, in the gods which they have created for themselves, to have given form to a forefeeling of this higher development.—PROF. MAUDSLEY, *in Popular Science Monthly.*

COLOGNES FOR THE SICK ROOM.

Our pharmaceutists are well aware of the fact that during the past years we have had innumerable compounds and chemicals offered as antiseptics, the merits of each being vaunted and extolled in its turn. After repeated trials of these new remedies, there is still a feeling predominant among those interested in the subject, that the desideratum has not yet been acquired. Some of the best disinfectants are in themselves objectionable; they either possess a disagreeable odor, or will stain and corrode. Ferrous sulphate (copperas) and manganous sulphate, though not really offensive, are comparatively inert. Iodate of calcium prevents decomposition, but if used as a local application causes too much pain. Acetic acid or vinegar is at first grateful and refreshing, but becomes sickening. Chloride of lime (erroneously so-called), as the formula shows, Ca (OCl) Cl, is an uncertain compound, whose virtue depends wholly upon the amount of free chlorine it liberates; chlorine being an irritant, corroding gas, no one would desire to have it in a room containing articles of vertu or delicate metallic ornaments. Potassæ permanganas (permanganate of potassa) is also a very good disinfectant; but unless sprinkled and brought into contact with the air, is not so effective as thought, and in sprinkling the solution, it will necessarily produce stains upon everything it may come in contact with; hence this is not at all desirable. Hydrate chloral is quite offensive, and the vapor stupefying. Acid carbolic or phenol, to which so much has been ascribed, is perhaps the best antiseptic we have in use at the present day, but its odor is certainly intolerable to an invalid; its preparations are less useful as they are less offensive.

I have now fully delineated the objections to the various disinfectants for the use of the sick-room, as per my investigations and experience. What we need, in my opinion, is a preparation that shall possess equal, if not greater, efficacy than any now in use, without irritant properties and unpleasant odor. Such a body, we hope is to be found in salicylic acid.

No theory as to the manner in which salicylic acid exerts its influence has been advanced, but it probably acts as an anti-ferment, and in this manner annihilates the organic bodies produced by fermentation.

The following formulas are such as I have experimented with to my own satisfaction, and only hope they may prove as effectual and as satisfactory in the hands of others:

No. 1 ℞—Acidi salicylici...ʒ ss.
Spiritus vini rectificati..................................f ℥ iv.
Olei cinnamomi...gtt. j.
" bergamii...gtt. xv.
Balsami Peruani...f. ʒ ss.
Make a solution.

In order to make a solution of the above formula, dissolve the balsam of Peru in the spirits and filter, then adding balance of ingredients. The aromatics used in perfuming the above solution are as nearly chemically compatible to salicylic acid as practicable.

No. 2. ℞—Acidi salicylici. ....gr. xx.
Olei gaultheriæ...gtt. v.
Spiritus vini rectificati diluti..........................f ℥ ij.
Mix.

In the above recipe, in the place of olei gaultheriæ you may add same amount of olei anisi, which is also of itself a powerful deodorizer, and may be preferred by many.

The basis of these solutions are salicylic acid, and any other combinations of odors can be added if desired which would harmonize with the salicylic acid. I give one for an example:

Salicylic acid ....gr. xx.
Farina cologne..f ℥ ij.
Mix.

You will find any one of the above recipes adapted for the use in sick-chambers to neutralize the infected atmosphere attending fevers. In typhoid fever it will neutralize the fecal evacuations, which are pre-eminently contagious. In rooms that have been closed for months, without necessary ventilation, it would destroy the microscopic fungous growths inevitably present. The lotion should be diffused in the room with the aid of a spray tube or atomizer. Its presumptive analogy to benzoic acid would suggest its application as a cosmetic, the lotion to be added to the water used for ablution. A dilution applied to erysipelas is productive of ease to patients. Its balsamic properties promote the healing of cuts and sores, besides freeing them from morbid atmospheric influences.

I hope I have shown the many advantages and powers of salicylic acid over other disinfectants to the entire satisfaction of the readers.

Although, owing to the comparatively high cost of salicylic acid, it would possibly not be brought into general use, yet for minor purposes of disinfection its introduction in such a form will doubtless be met with a fair demand.

The name of such a preparation might be appropriately called *Lotio Antiseptica Fragrans* (Fragrant Antiseptic Lotion), which, in my opinion, gives the properties of the lotion in its name.—George Leis, *in Druggists' Circular*, April, 1877.

SULPHO-CARBOLATE OF SODA IN SCARLET FEVER, DIPHTHERIA, ETC.

Dr. G. D. Beebe, of Chicago, in a communication to the *Tribune* of that city, maintains that scarlet fever, diphtheria, erysipelas, and certain other forms of epidemic or contagious diseases, owe their malignity to septic germs or living organisms in the blood. He says that he came to this conclusion with regard to diphtheria more than ten years ago, and accordingly the tried internal administration of carbolic acid to destroy the germs. The results were satisfactory, many desperate cases recovering rapidly under this treatment. He was subsequently led to regard erysipelas as of septic origin, and the certainty with which the disease is arrested by the internal use of an efficient antiseptic seems to him a complete demonstration of this view. Fully eight years ago he predicted that scarlet fever would some time be proved to be as clearly of septic character as diphtheria, but it is only within the past two years that he considers this to have been demonstrated. He goes on to say :—

The first antiseptic administered internally, in my own practice, was carbolic acid ; but it was never used with entire satisfaction, because it could not be diffused through the blood in sufficient quantity to destroy the living germs, without producing toxic effects of its own ; and it was, besides, objectionable on account of its odor and taste. The sulphites, especially the sulphite of soda, was found to be quite diffusive, but lacked energy, and hence efficiency. In the chemical combination of the carbolic acid with the sulphite of soda (or the sulpho-carbolate of soda) we have all the objectionable qualities reduced to the minimum, while all the desirable properties are retained.

During nearly two years I have administered this salt in many hundreds of cases of scarlet fever and diphtheria, as well as a reasonable number of cases of erysipelas and puerperal fever—both with a view to the prevention of epidemic contagion and in the treatment of these forms of disease.

The sulpho-carbolate of soda is readily soluble, and very diffusive when brought within reach of the absorbents. It is odorless, and of a taste differing but little from soda.

By its administration the blood and tissues of the human body may be thoroughly disinfected without exciting any toxic effects of the drug. Administered to children breathing an atmosphere loaded with scarlet fever or diptheritic contagion, it acts as an absolute preventive, with exceptions so rare, and with symptoms so slight when any appear, that one is forced to believe that the fault was rather in an insufficient dose than in the agent. Given when either of these diseases has developed an attack, and within a few hours the activity of the disease has ceased, and the remaining symptoms speedily fade out into health.

I cannot dismiss this subject without a warning to those who pretend to make use of this agent, but use so small a quantity as to be utterly valueless. I do not know that this agent posesses any other therapeutic properties than as an antiseptic ; and to be useful as such, it must be given in quantity sufficient to disinfect the blood, otherwise it will be as useless in the face of these diseases as the spray of an atomizer in extinguishing a conflagration.

SPRING FEVER: HOW NOT TO HAVE IT.

In the *Christian Union*, a writer gives the symptoms and several remedies for a very common complaint, prevalent with almost every one to a greater or less extent at this season of the year :

The hampered body, says the writer, which has been coddled, petted, stuffed with carbon-bearing fats, and calorified in every possible way, begins to protest. The machinery is clogged ; headache, dyspepsia, and the thousand nameless sensations of discomfort which we charge to variable weather, afflict and hamper poor humanity. To-day the fog depresses our vital forces, to-morrow the brain is pierced with blinding sunshaft; and so each day's external is made responsible for internal shortcomings. The *litterateur*, in atrabilious humor, afflicts the world with morbid philosophy. The pastor sees weak humanity more than ever sinful, and his Lenten homilies are unconsciously tinctured with a deeper dye for the pangs of his own mortality. The housewife, in overheated rooms, with a monotone of circumscribed care and too little outside diversion, finds dirt and despair in the kitchen, chaos in the nursery, a forlorn hope in her mending baskets.

Among other remedies for people who say, "I always have a bilious attack in the spring," the following seems the most potent:

On rising sponge the body lightly and quickly with cold water, briskly toweling after. It is not necessary that this be a long or laborious operation; the more rapidly the better, with sufficient friction to bring a glow to the skin. If you cannot secure time to go over the whole bodily surfaee, at least make a point to daily sponge the trunk and arms. Rousing and stimulating the whole system, clearing and opening the pores, it imparts an indescribable freshness and exhilaration, amply repaying the effort. Rehabilitated, you are now ready for your morning bitters, namely, the clear juice of a fresh lemon in a wineglass of water, without sugar. This is a bomb straight at the enemy, for a more potent solvent of bile is not in the *materia medica*. Searching out rheumatic tendency, attacking those insidious foes which are storing up anguish against our later days—calculi—it pervades the system like a fine moral sense, rectifying incipient error. It is needful, perhaps, to begin with two lemons daily, the second at night just before retlring.

A primitive but most efficacious prescription, which corrected the physical reaction after a pork-eating winter for our ancestors, was a wineglass full of very hard cider, made effervescent by a crumb of sal soda. More potent and palatable is the concentric force of the pure lemon acid.

We venture to claim for this self-treatment alone, faithfully applied, more relief for the body and stimulus to the mind than from a battery of pills or a quarts of herb decoction.

ALCOHOL AS AN ARTICLE OF DIET. — Dr. T. Edes, Professor of Materia Medica in Harvard University, read a paper on this subject at the last meeting of the American Social Science Asssociation, in which he comes to certain conclusions, which are summarized in the *Boston Medical and Surgical Journal* as follows:—

1. Under some circumstances alcohol may be a food. These are:—

(*a*.) The deprivation of nourishing and sufficiently varied and abundant rations, as in the case of soldiers, sailors, laborers, etc.

(*b*.) When for any reason ordinary food is not well assimilated, or the system has become habituated to alcohol, as in some rare intances of habitual topers and in some wasting diseases.

This substitution should be a matter of necessity and not of choice.

2. The healthy man, with a full and varied supply of food, needs absolutely no alcohol. Wine with food sometimes assists digestion; but the digestion which needs the aid is either enfeebled or overburdened. The most severe and long continued labor can be carried on better without alcohol than with it. This is in most cases especially true of mental labor.

3. In the few cases in which this is not true, and where a small quantity of alcohol suffices merely to restore the normal vigor without excitement, the previous condition is probably one of somewhat impaired vitality, perhaps more especially affecting the heart. As an addition to a diet already sufficient, alcohol is to say the least, useless in perfect health.

4. An occasional use of light wine or beer is a luxury and not a necessity. Experience shows that such a use cannot be regarded as seriously detrimental either to bodily or mental vigor.

5. After a fatiguing day's work, as a relaxation and agreeable change, or as a prelude and assistance to the digestion of more appropriate food, alcohol may be looked upon as approaching more nearly to a true stimulant or restorative action than under any other circumstances in health. We then expect from it neither intoxication nor reaction.

6. An habitual overdose of alcohol leads to degeneration of important organs and undermines the vital powers.

7. There may be moral reasons for total abstinence entirely distinct from the physiological.

8. The introduction of the use of light wine and beer, though not desirable in a community already in a state of ideal physical and moral perfection, is highly desirable as a substitute for the use of stronger liquors.

SCIENTIFIC MISCELLANY.

FRUIT LISTS AND FOREST TREES FOR KANSAS.

The following fruit list was prepared some three years ago with the aid of Prof. S. T. Kelsey, then a resident of the State, and one of the most practical fruit growers in the West. It has in the main stood the test since that time. It was then prepared to answer the many questions relating to fruit growing in the State, and is now reproduced for the same reason:

GENERAL LIST.

Summer Varieties, in the Order of Ripening.—Carolina Red June, Early Harvest, June Sweet, Cooper's Early White.

Autumn Varieties, in the Order of Ripening.—Lowell, Maiden's Blush, Rambo, Barley's Sweet, Fameuse.

Winter Varieties, in the of Order Ripening.—Jonathan, Wagner, Missouri Pippin, Winesap, McAfee's Nonsuch, Rawle's Janet or Geneting, Ben Davis, Gilpin or Little Romanite.

ADDITIONAL LIST.

Summer Varieties, in the Order of Ripening.—Early Pennock, Golden Sweeting, American Summer Pearmain.

Autumn Varieties, in the Order of Ripening.—Fall Wine, Gravenstein, Buckingham, Smokehouse, Wine (syn. Pa. Redstreak), Ortley.

Winter Varieties, in the Order of Ripening.—Yellow, Belleflower, Red Winter Pearmain, or Red Lady Finger, Smith's Cider, Roman Stem, Swaar.

PEARS.

Standards, in the Order of Ripening.—Bartlett, White Doyenne, Seckel, Lawrence, Beurre Easter.

Dwarfs.—Bartlett, Louise bon de Jersey, Duchesse'd' Angouleme, Beurre Deil, Ott, Seckel, Beurre Easter.

Pear blight has destroyed most of the pear orchards planted at an early day. No locality, kind of soil or exposure seem to have an immunity from this destructive disease. It is a serious question whether this delicious fruit can be grown successfully in Kansas. No other obstacle seems to be in the way. Trees grow thriftily, and bear immense crops, until overtaken with blight.

PEACHES.

Hale's Early, Early Tilloston, Early York, Coolidge's Favorite, Stump the World, Old Mixon Free, Yellow Alberge, President, Gross Mignonne, Morris White, Heath's Cling, Ward's Late Free.

Good yields of peaches may be relied on once in three years. A few favored localities will do better than this, but they are exceptional.

CHERRIES.

Early Richmond, English Morello.

PLUMS.

The improved varieties of this fruit do not succeed well in this State on account of the curculio. Occasionally a person will secure partiial crops of the Lombard, German Prune, and Blue Damson, by destoying the curculio each day, but it becomes an expensive luxury. Among the wild varieties, however, occasionally one is found that is very good. Selections have been made in Wyandotte county of some three varieties, one red and two amber color, that ripened in succession, the first in July. They are thin-skinned, sweet, and entirely free from that peculiar astingent property that is so peculiar to the wild varieties. We are informed that in the southwestern part of the State, near the Arkansas river, there are some very good varieties, that have found their way to the Topeka, Kansas City and other markets, in the eastern portion of the State.

GRAPES.

General List.—Concord, Ives Seeding. The varieties succeed well in all parts of the State. The Concord is the grape for the million. The Ives has the merit of ripening about ten days earlier than the Concord, and therefore lengthens the season. This, however, can be accomplished with the Concord alone, by planting upon different exposures. A southern or eastern exposure will ripen the fruit from eight to twelve days earilier than a northern or western.

Additional List.—Delaware, Martha, Catawba, Goethe, Allen's Hybrid, Dracut Amber. Those mentioned in this list (and many other varieties might be named) succeed well in some localities, but are not reliable throughout the State for general culture.

OTHER SMALL FRUITS.

Currants.—Large Red Dutch, White Dutch, White Grape, Cherry. Currants do well in Kansas if properly shaded and thoroughly mulched. The north side of an east-and-west fence is a good place.

Gooseberries—Houghton's Seedling, American Seedling.

Blackberries.—Kittatiny.

Raspberries.—Doolittle's, Miami.

Strawberries.—Wilson's Albany.

FOREST TREES.

This and the succeeding list was furnished by Prof. S. T. Kelsey:

For Forest.—Black Walnut, Cottonwood, Silver Maple, Osage Orange, Ash and Red Cedar.

Ornamental.—Ash, Elm, Catalpa, Box Elder, Osage Orange, Sycamore, Golden and White Willows.

Evergreens.—Red Cedar, Austrian, Scotch and White Pines.

Hedge.—Osage Orange.

The following list of twelve varieties of apples best adapted to Kansas was prepared, by request, by W. E. Barnes, a nurseryman of ripe experience, of Vinland, Douglas county. Mr. B. places Jonathan in the fall list. Northern varieties ripen earlier here, and it is hard sometimes to make a distinction between late fall and early winter varieties:

Summer.—Red June, Cooper's Early White, Lowell.

Fall.—Maiden's Blush, Jonathan, Pennsylvania Red Streak.

Winter.—Missouri Pippin, Ben Davis, Winesap, Willow Twig, Rawle's Genet, McAfee's Nonsuch.—HON. ALFRED GRAY, *Secretary Kansas State Agricultural Society.*

A SMALL FLOWER GARDEN.—A writer in the *Western Farm Journal* recommends for a small flower garden the following list, as they do not require treatment, are good sturdy varieties, will stand neglect, yet do well: Asters, balsams, dianthus, petunias, phlox, calliopsis, verbenas, sweet peas, mignonette, zinnias, marigolds and portulacas. The same writer again says: "The plants I have named will afford a profusion of flowers from June to October. Phlox will be the first to blossom, and then petunias will come on, and both of these flowers continue to increase in beauty until hard frosts come. Asters will be in perfection in August and September. Calliopsis begins to blossom in July, and nearly all the others come on early in that month. If old flowers are removed and not allowed to go to seed, you will have a much greater profusion of bloom. If you do not remove faded flowers, but allow them to perfect seed, you will soon see that your plants are losing a large share of their former glory. You can't expect a plant to ripen seed and bloom profusely at the same time."

Analysis of Sweet Springs Water, Saline County, Mo.

	Grains.
Chloride of Sodium	89.91773
Chloride of Potassium	3.39796
Chloride of Lithium	0.04756
Chloride of Magnesium	22.29123
Chloride of Calcium	14.72127
Bromide of Magnesium	0.11801
Sulphate of Lime	9.45713
Carbonate of Lime	9.56312
Carbonate of Iron	0.56656
Carbonate of Manganese	0.00190
Alumina	0.08921
Silica	1 08471
Organic Matters	4.05300
Total	155.00028

Per gallon 231 cubic inches.

Origin of Petroleum.—Mr. H. Byasson has been led by the following experiment to give a scientific explanation of the formation of petroleum: If a mixture of vapour of water, carbonic acid, and sulphuretted hydrogen be made to act upon iron heated to a white heat in an iron tube, a certain quantity of liquid carburets will be formed. This mixture of carburets is comparable to petroleum. The formation of petroleum can thus be naturally explained by the action of chemical forces. The water of the sea, penetrating into the cavity of the terrestial crust, carries with it numerous materials, and especially marine limestones. If the subterranean cavity permits these new products to penetrate to a depth where the temperature is sufficiently high, in contact with metallic substances, such as iron or its sulphurets, we have a formation of carburets. These bodies will form part of the gases whose expansive force causes earthquakes, volcanic eruptions, etc. Petroleum is always found in the neighborhood of volcanic regions or along mountain chains. In general it will be modified in its properties by causes acting after its formation, such as partial distillation, etc. Petroleum deposits will always be accompanied by salt water or rock salt. Often and especially where the deposit is among hard and compact rocks, it will be accompanied by gas, such as hydrogen, sulphuretted hydrogen, carbonic acid, etc.—*Revue Industrielle.*

CHEMICAL PRIZES.—Among the prizes offered by the German *Verein zur Beförderung des Gewerbfleisses*, the following may prove of interest to our readers:

A silver medal, or its value, and 900 marks (about $200) for an opaque red enamel for gold, silver, copper and bronze.

A gold medal, or its value, and 3,000 marks, for a substitute for caoutchouc, the same for a suitable substitute for gutta percha.

A prize of 1,000 marks for a concise, critical and practical treatise on cements; also 1,500 marks for the best investigation of the cause of a change in the zero point of thermometers, with a method of preventing or remedying it.

A prize of 2,000 marks for the best series of iron and manganese alloys; at least twenty samples to be prepared, containing from 0.5 to 5 per. cent. of manganese.

TO DISTINGUISH BETWEEN COTTON AND WOOL IN FABRICS.—Ravel out the suspected cotton fibre from the wool and apply flame. The cotton will burn with a flash, the wool will curl up, carbonize, and emit a burned, disagreeable smell. Even to the naked eye the cotton is noticeably different from the filaments of wool, and under the magnifier this difference comes out strongly. The cotton is a flattened, more or less twisted, band, having a very striking resemblance to hair, which, in reality, it is; since, in the condition of elongated cells, it lines the inner surface of the pod. The wool may be recognized at once by the zig-zag traverse marks on the fibres. The surface of wool is covered with these furrowed and twisted fine cross lines, of which there are 2,000 to 4,000 in an inch. On this structure depends its felting property. Finally, a simple and very striking chemical test may be applied. The mixed goods are unravelled, a little of cotton fibre put into one dish and the wool in another, and a drop of strong nitric acid added. The cotton will be little or not at all affected; the wool, on the contrary, will be changed to a bright yellow. The color is due to the development of a picrate.—*Warehouseman.*

THE *Gardener's Chronicle* announces a new material for paper in a well known American grass, *Zizania aquatica.* It is stated that the Zizania yields fully as much of the raw material as esparto, and has the great and peculiar merit of being comparitively free from silicates. Paper made from it is quite as strong and quite as flexible as that made from rags; it is easily bleached, economical in respect of chemicals, pure in color, and remarkably free from specks and blemishes. It is especially recommended for the manufacture of printing paper. The grass grows in enormous quantities in our Canadian Dominion, on the shores of Lakes Erie, St. Clair, Ontario, &c., and it is affirmed that a supply of 100,000 tons annually may be looked on as certain. Its habitat is swamps, ponds, and shallow streams, where it grows to a height of from 7 to 8, or even to 12 and 14 feet. The structure is similar to that of rice, except that the flowers are unisexual. The grains are largely used as an article of food by the native Indians, some tribes depending on them to a large extent for their subsistence. The flavor is said to be superior to that of most other cereals, and it has long been known from these properties as "Canada Rice."—*Nature.*

Sawdust in Rough Casting.—Siehr recommends very highly the use of sawdust in mortar, as superior even to hair for the prevention of cracking, and subsequent peeling off, from rough casting under the action of storms and frost. His own house, exposed to prolonged storms on the sea-coast, had patches of mortar to be renewed each spring; and, after trying without effect a number of substances to prevent it, he found sawdust perfectly satisfactory. It was first thoroughly dried, and sifted through an ordinary grain sieve, to remove the larger particles. The mortar was made by mixing one part of cement, two of lime, two of sawdust and five of sharp sand, the sawdust being first well mixed dry with the cement and sand.—*Scientific American.*

Dried Eggs.—A large establishment has been opened in St. Louis for drying eggs. It is in full operation, and hundreds of thousands of dozens are going into its insatiable maw. The eggs are carefully "candled" by hand—that is, examined by light to ascertain whether good or not—and are then thrown into an immense receptacle, where they are broken, and by a centrifugal operation the white and yoke are separated from the shell very much as liquid honey is separated from the comb. The liquid is then dried by heat, by patent process, and the dried article is left, resembling sugar; and it is put in barrels and is ready for transportation anywhere. This dried article has been taken twice across the equator in ships, and then made into omelet, and compared with omelet made from fresh eggs in the same manner, and the best judges could not detect the difference between the two. Is this not an ages of wonders? Milk made solid, cider made solid, apple butter made into bricks! What next?—*Philadelphia Trade Journal.*

The Smithsonian Institution.—Professor Joseph Henry says that he has been trying for years, in regard to the Smithsonian Institution, to get the government to understand that the great testator never intended, by his munificent gift, to accumulate a mere deposit of scientific works, but to collect all manner of new information for distribution among the nations of the earth. He has at last accomplished this. Chief Justice Waite takes the same view, and the institution is now sending contributions of American discoveries, science, art, anliquities, history and inventions generally, to more than 2,000 universities and colleges in every civilized portion of the globe, and these in exchange return to us the printed evidence of their own successful reseaaches in in all these various studies and inquiries. Both these contributions from us to distant nations and from the distant nations to us are delivered free of cost, by order of the respective governments. Owing to careful investments in United States securities, there remains to-day to the credit of the institute $714,000.—*Scientific American.*

TRIALS have been made in Rome of a solution of chloride of calcium as a substitute for water in laying dust in streets, and the results are said to have been highly satisfactory. The dampness communicated to the road remains for a whole week. The road remains damp without being muddy, presenting a hard surface, on which neither the wind nor the passing of pedestrians or has any effect.

EDITORIAL NOTES.

THE eleventh annual meeting of the Medical Society of the State of Missouri was held in this city, during the third week of April, and was attended by about eighty physicians from various portions of the State. Dr. J. W. Trader, of Sedalia, presided, and Dr. Chesney, of St. Joseph, acted as Secretary, *pro tem.*, in the absence of Dr. Schauffler, the regular Secretary.

Very interesting papers were read by Drs. Higgins, Brown, Richmond, Spencer, Glasgow, Porter, Todd and Lewis.

The officers elected for the ensuing year are as follows: *President*—F. M. Johnston, of Platte City. *First Vice President*—D. R. Porter, Kansas City; *Second*, E. C. Evans, Sedalia; *Third*, N. F. Essig, Plattsburg; *Fourth*, W. C. Glasgow, St. Louis; *Fifth*, P. S. Fulkerson, Lexington. *Recording Secretaries*—A. J. Steele, St. Louis, E. W. Schauffler, Kansas City. *Corresponding Secretary*—C. L. Hall, Marshall, Mo.; *Treasurer*—Jacob Geiger, St. Joseph.

The next meeting will be at Brownsville, Mo.

ON the evening of April 15th, the Rev. J. G. Roberts, pastor of the Congregational church, of this city, delivered a very able and interesting lecture upon "The Conflict between Science and Religion," which was listened to with marked attention by his audience, and was subsequently published in the *Journal of Commerce.*

DR. GEORGE E. HEYDON, of this city, has been delivering a course of scientific lectures in the neighboring towns, that have been very well received as we are informed.

GENERAL DI CESNOLA's book on Cypriote antiquities will be published by Murray this fall. Title, "Cyprus, its Ancient Cities, Tombs and Temples." It will be published in splendid style; 500 royal octavo pages and more than 500 costly illustrations, Mr. Murray sparing no expense to make this contribution to antique art worthy of both the subject and the illustrious author. Every gem in General Cesnola's antique collection will be perfectly reproduced in its pages.

BOOK NOTICES.

POPULAR SCIENCE MONTHLY. May, 1877. Conducted by E. L. Youmans. Published by D. Appleton & Co., New York. $5.00 per annum; single numbers, fifty cents.

Contents for May: Gar-Pikes, Old and Young, by Prof. Burt G. Wilder, illustrated. Mesmerism, Odylism, Table-Turning and Spiritualism, by William B. Carpenter, LL. D., F. R. S. Aqueducts, by William E. Simmons, illustrated. Gravitation and How it Works, by Granville F. Foster. On the Habits of Ants, by Sir John Lubbock, Bart. The New Star in the Constellation of the Swan, by Amédée Guillemin, illustrated. Antique Marbles, by John D. Champlin, Jr. On the Wonderful Divisibility of Gold and Other Metals, by Alexander E. Outerbridge, Jr. Movements of Jupiter's Cloud-Masses, by Richard A. Proctor. Toadstool-Eating, by Julius A. Palmer, Jr. Sketch of President Barnard, with portrait. Correspondence. Editor's Table: Mental Overwork under the Competitive Prize System—The Relative Importance of Ideas—Concerning "Blue Glass." Literary Notices: Bagehot's English Constitution, and other Essays—Spencer's Principles of Sociology—Prescott's Electricity and the Electric Telegraph—Tyndall's Lessons in Electricity—Wright's Philosophical Discussions—Wallace's Russia, etc. Popular Miscellany: Cotton Culture in Egypt—Testimonials to Mr. Darwin—Ignorant Enterprise—Production of Near-Sightedness in Schools—Astronomical Observations on the Rocky Mountains—Influence of Heat on Galvanic Conductivity, etc. Notes.

STRENGTH AND CALCULATION OF DIMENSIONS OF IRON AND STEEL CONSTRUCTIONS, with reference to the latest experiments. Translated from the German of J. J. Weyrauch, Ph. D., Prof. Polytechnic School of Stuttgart, with four folding plates. New York: D. Van Nostrand, publisher, 1877.

This little work of 112 pages is designed to give the general results of many experiments lately made in Germany, England, Sweden and America, to determine the properties of iron and steel, and especially to point out some serious errors in the methods of calculating the dimensions of constructions of these metals, which have led engineers into erecting insecure structures in bridges and buildings. The many accidents occurring in railroad bridges and large public buildings lately, render such a work especially valuable just at this time, and it is claimed that by its careful study practical engineers will be placed at the present standpoint of critical judgment.

We have quoted two chapters from this brochure, under the head of Technology, which give an idea of the general scope of the first part. The remainder of the work is devoted to similar subjects of discussion, together with formulas, calculations, laws, tables and plates, all of which must be of inestimable advantage and value to civil engineers.

"Shall We Ever Reach the Pole?" London: Provost & Co., 36 Henrietta Street. 1877.

This is a pamphlet by an anonymous writer, who takes the remarkable position that the earth must be hollow around the axis, in consequence of its rotary motion, *i. e.*, that the axis is a kind of cylinder more or less enlarged as the velocity of the rotary motion about it varies.

Various other novel propositions respecting the conditions at the Poles are supported with considerable ingenuity, and the work is well worthy of perusal.

Circular 6. Monthly Reports of the Kansas State Board of Agriculture, for February and March, 1877, by Alfred Gray, Secretary.

The Board of Agriculture of the State of Kansas has wisely resolved to expend the appropriations, heretofore made by the legislature for annual fairs and cattle shows, upon official publications, such as annual and monthly reports, for general distribution. These reports are carefully prepared by the secretary, Hon. Alfred Gray, who is a most able and efficient officer.

The number before us contains a large amount of valuable and interesting information concerning the soil, climate, products, railroads, public lands, cost of living, taxes, etc., which must necessarily be of great service to those persons proposing settling in Kansas.

Publications Received.—Popular Science Monthly for May, 1877; Library Table—New York: American Bookseller; Chicago Field, Vol. 7, No. 9; Fruit Recorder, Rochester, New York; Journal of Applied Science, London, January, February, March and April, 1877; Druggists' Circular and Chemical Gazette, April and May, 1877, New York; American Meteorologist, J. H. Tice, St. Louis, March, 1877; Description of Sweet Springs, Brownsville, Mo.; Catalogue Marietta (Ohio) College, 1876–7; Monthly Report State Board of Agriculture, Kansas; Leavenworth *Times*, daily; Boston Journal of Chemistry, April, 1877.

WEATHER RECORD FOR APRIL, 1877.

Day.	Prof. Tice's Forecasts.	Signal Service "Indications."	Actual Observations at Kansas City.	7 A. M.	2 P. M.	10 P.M.
1	1st to 5th variable, *F. b.,	clear, R. t., warm.	clear and very windy.	35°	45°	33°
2	R. t., cloudy and threat-	F. b., cooler, cldy.	cloudy and variable.	25	40	35
3	ing weather, raining	warmer, clr, cldy.	snow & rain A. M., clear P. M.	35	51	45
4	with severe storms in	" " "	clear A. M., thund'r stm P. M.	40	61	44
5	places.	R. t., F. b, clear.	pleasant all day.	41	77	61
6	6th to 8th †R. b., F. t.,	" " "	" "	51	71	58
7	clear and	" " "	cloudy and raining all day.	51	53	52
8	fair weather.	F. b., cloudy.	" " "	45	50	48
9	9th to 11th. F. b., R. t.,	" " rain.	clear A. M, cloudy P. M.	44	53	42
10	cloudy and threatening,	" "	cloudy all day.	41	50	44
11	with rain in places.	R t., F. b., cloudy	pleasant but cloudy.	47	60	53
12	12th to 14th, R. b., F. t.,	" " "	cloudy and sprinkling.	47	57	52
13	with clear or	" " "	clear and pleasant all day.	50	61	50
14	fair weather.	" " "	" " "	46	61	52
15	15th to 18th, F. b., R. t.,	warmer, rain.	cloudy A. M., clear P. M.	50	72	63
16	cloudy and threatening,	cloudy & stormy.	rained hard, high west wind.	60	65	69
17	with heavy rains and	rain, cldy, stormy	cldy all day, storm at night.	60	74	57
18	storms in places.	rain, cool'r, h.wnd	cloudy A. M., rained all P. M.	60	61	54
19	19th to 20th, R. b., F. t.,	cloudy, high wind	cloudy and drizzling all day.	51	56	48
20	clear or fair.	" " "	clear and pleasant.	44	61	51
21	21st to 23d, F. b., R. t.,	clear, R. t., s wind	" "	54	69	57
22	cloudy and threatening,	cldy, warmer, F. b	" "	58	76	67
23	with rains.	cloudy and cool.	cloudy "	56	64	58
24	24th to 25th, R. b., F. t.,	" "	" "	47	70	62
25	clear or fair.	cool, clear fair.	cloudy and cool, n. e. wind.	50	60	53
26	26th to 29th, F. b., R. t.,	F. b., cool, cldy.	cldy & cool, rained at night.	51	68	56
27	cloudy and threatening,	R. t., warm.	clear & warm, rained at night.	59	62	46
28	with heavy storms in	F. b., cool, cloudy	cloudy and cold.	37	37	36
29	places.	" " "	cloudy and cold, n. wind.	37	50	41
30	30th, R. b., F. t., clear.	R. t., " "	clear and pleasant, with frost.	40	64	46

* Falling barometer, Rising temperature; † Rising barometer, falling temperature.

As Prof. Tice's forecasts are intended to cover the entire continent he divides the time into periods of three or four days each, because it requires that length of time "for a storm-centre to pass from west to east across the continent." The Signal Service predictions apply to the Upper Mississippi and Lower Missouri Valleys.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

VOL. 1. JUNE, 1877. NO. 4.

ARCHÆOLOGY.

Age of "Prehistoric" Remains Found at Kansas City, and of the Races of Men Associated with Them.

BY JUDGE E. P. WEST.

[Read before the Kansas City Academy of Science, September, 1876.*]

Mr. President, Ladies and Gentlemen:—I have the pleasure of presenting before you this evening several fragments of the handiwork of our "old settlers," which will possess great interest, no doubt, to those who are fond of contemplating relics of the past. Unlike the annual reunions of our modern "old settlers," the reunions of the "prehistoric old settlers," of whom I have the pleasure to speak this evening, long since have been buried in the mysterious vistas of the past, or have been transferred from scenes of earth to those of their happy hunting grounds in the poetic realms of the Great Spirit.

I invite your attention first to a fragment of chert, which I had the good fortune to find the latter part of the past spring, imbedded in the Loess or Bluff formation. It was found at a depth of about three feet beneath

*This paper should have preceded the one read by Judge West before the Academy of Science, which was published in the first number of this Magazine.

the present surface, near the intersection of Missouri avenue and Troost avenue in Kansas City, and about twelve hundred feet from the ancient shore line of a former lake, of which I shall hereafter have occasion to speak. Its position was such as to leave no doubt that it must have been deposited where I found it at the time the Bluff formation was yet going on, and probably about its close in this locality.

As chert, this fragment has a long and interesting history to those who can trace its various transmutations down through innumerable ages in the past. But, what will claim our attention this evening is its connection with the history of man. You will perceive that it has been fashioned by the hand of man into a spear head, or arrow head, for use in war and the chase, and affords unmistakable evidence of former association with him, evidence which it has faithfully preserved through vast ages and now presents to us, with all the truthfulness in detail as when it first received man's impress upon it. It stands before us now, a mute, unerring witness of man's great antiquity.

To approximate the time of its association with our race, which gives to it its great interest, we must consider the age of the formation in which it was found imbedded. Some of you, no doubt, will remember that excavations were made in the bed of the Missouri river for the purpose of obtaining a solid foundation for the piers of the railroad bridge erected across it at this place. Solid rock was not reached at the fifth pier from the left bank until the excavation had attained a depth of sixty-eight feet below the present river bed. From the fifth pier north solid rock was not reached at a greater depth than that here indicated, and the piers rest upon piles driven into the drift. From the fifth pier southward there is a gradual upward slope of the rocks to the southern shore line, where they are exposed above the surface in the south bank of the river. This rock formed the old bed of the river, which, sloping downward toward the north bank, is at an unknown depth lower than the present bed.

At this time it is probable that the Kansas river had its outlet into the Missouri at or near the present mouth of the Big Blue river; its channel then passing along the McGee creek valley, in the south part of the city, by way of Judge Carey's, thence along Goose Neck creek valley to the present channel of the Big Blue, not far above where it empties in to the Missouri.

I was informed by Gov. W. P. Hall, of St. Joseph, several years ago, that in the excavations made for the piers of the railroad bridge across the Missouri at that place, large boulders, worn pebbles, sand, and other drift material were encountered, forming the entire matter excavated down to the solid rock which marks the old bed of the river at that place. The same is true of the excavations made here; boulders, worn pebbles, sand, and drift material were found in the excavations made, reaching down entirely to the rock forming the old river bed. Our present river channel, at this place, occupies a position over the south edge, or slope, of the old and now buried channel. When this portion of our continent was at a greater elevation than at present, and our river channels much deeper than now, which is manifest from the great thickness of the drift material that overlies the undisturbed rocks which form the bottom of the old channels and marks their course, the long glacier period began. Glaciers were formed which extended from the North Pole to about the thirty-eighth degree of north latitude, having a thickness of thousands of feet, and overtopping nearly all of our mountains. During this period this irresistible mass, moving down from the north, filled the old channels of our streams and diverted some of them, as the Kansas river, which I have just alluded to. It is at the close of this long period that the computation of time associating man with this mute witness, this unmistakable work of his hand, properly begins.

At the close of the glacial period, this portion of our continent, which, during that time, had suffered great depression and was submerged, again emerged from the water and marked the beginning of our present river channels. But the emergence was not so complete but that there were left numerous lakes of various magnitudes, extending over a vast area of country, including the drainage of the Platte, the Missouri, the Mississippi, the Ohio, the Hudson, the Niagara, the St. Lawrence, and other streams east of the Rocky Mountains, as well, perhaps, as those west of these mountains. It was in these residuary lakes that the Loess, or Bluff deposit took place, precipitated from the sediment borne into the lakes by the streams affording their supply. But what is more particularly associated with my subject for this evening is the Loess formation of the Missouri, and especially at Kansas City. We have here at least three periods, or more properly, levels of Bluff deposits, one overtopping all, or nearly all, of our rocky bluffs, the other two at lower levels, corresponding with the terraces in the bluffs overlooking West Kansas. At the highest level the river, or, rather more properly, the lake into which it flowed, was probably thirty miles or more in width, embracing a large portion of its present drainage. Vast as must have been the volume of water, irresistible as must have been the floods coursing down the Missouri's water-way, produced by a much greater annual rain fall than we have at present, and the melting away of the annual snows reinforced by the melting of the retiring ancient glaciers, we are still not justified in believing that a river so vast in volume, so expanded in breadth as thirty miles or more from shore to shore, with a depth of several hundred feet, a velocity exceeding that of the present Missouri at its flood, could have been maintained. Nor is such a stream consistent with the facts presented by the bluff formation along its oanks. Hence, we are led to the very reasonable conclusion, that the large bodies of water, which evidently prevailed, were lakes formed within the drainage of the river, along the general course of its channel, caused by obstructions across its way. The obstructions, no doubt, were caused by the filling up of the old channel of the Missouri, by which, in places, it was entirely diverted and the channel thrown across narrow, rocky barriers, as in the case of the Niagara. The obstructions could not have been caused by ice of the glacier period, for the Bluff deposit was subsequent to the glacier time in this latitude, and, besides, we find imbedded in the Loess numerous shells of the Helix asbora, H. concava, H. minata, and other land and fluviatile shells. These mollusks could not have endured the cold of the glacier time, nor could they have been transplanted from a warmer latitude. These obstructions being subsequently removed by erosion, drained the lakes formed by them, and left our Bluff formation as we now find it.

The shore line of the lowest level, or that corresponding to the second or lower terrace, in the West Kansas bluff, may be traced by the line of rocky precipice partially exposed, extending from the junction of Sixth street with Bluff street, thence running by the way of the Coates Opera House, thence deflecting northeasterly to the junction of Seventh and Main streets, thence along Seventh street to Troost avenue, deflecting again northeasterly, cutting Independence Avenue at its junction with Forest Avenue, and then along the bluffs west of Dykington Park, to the river bottom. The superincumbent strata had been entirely removed down to the Bethany Falls limestone, in this entire area and extending to the river, and embracing part of Wyandotte City, before the loess deposit began. The lake had now receded to within the denuded area here defined, and extended to the bluff and some way up Line Creek north of the river, and up Turkey Creek valley to the vicinity of Rosedale, south. This is the last level of the loess, which in this last mentioned area, is from eighty to one hundred feet in thickness.

Further evidence of the gradual retiring of the lake waters with intervals of more or less accelerated or retarded recession, and that the old channel of the Kansas river had its outlet along the line I have indicated, is to be found in an old channel which was formed about the time of the last level of the lake extending from the old channel of the Kansas river, in the south part of the city, to what was then the current of the Missouri river about the margin of the bluffs on the south side. This old channel may be traced along the general course of Main street to about Fifth street, where, bending northeastwardly, it was divided into two channels, one encountering the current of the Missouri about the foot of Grand avenue, and the other about the terminus of Charlotte street, at the brink of the bluffs. The evidence of the former existence of this channel is very conclusive and is to be found in the great quantity of land and fluviatile shells which lie imbedded in the loess where the water discharged through the old channel, encountered the current of the Missouri and was arrested by it, forming eddies into which the shells drifted and were covered by successive layers of sediment. Shells are not found here in the Loess except where their motion in drifting with the current has been arrested by opposing currents, so that they are encountered only at the two places where the current of the channel encountered the Missouri's current at the brink of the bluffs about the river terminus of Charlotte street and Grand avenue.

It was in this last level of Bluff deposit, and upon the east slope of the

the Charlotte street outlet of the channel, that I found the spear head I have shown you this evening, lost, no doubt, by

> "A brave old fisherman,
> All of the olden time,"

while providing for his daily wants from the fishes sporting in the channel.

The Loess formation, though comparatively very new, belonging to our own geological time, estimated by years as we compute time, is indeed very old. It had its beginning about the time the Niagara river commenced its erosion of the rocky barrier which causes that world's wonder, the Falls of the Niagara. Since that time the Niagara has cut a channel through the solid rock back for a distance of seven miles. The length of time required to accomplish this has been variously estimated by Dana, Lyell and other geologists, at from thirty-one thousand to one million years.

Prof. Aughey has estimated the time required for the deposit of two hundred feet in thickness of Loess at twenty thousand years. Reckoning our Loess deposit at one hundred feet, this spear head, from these estimates, must have lain where I found it for at least twenty-one thousand years, proving man's presence at Kansas City and upon this continent for at least that great length of time.

From the evidence of the specimen I have shown you, and from a stone axe described to me by Col. Van Horn, found in grading Commercial street, near the foot of Grand avenue, buried in the Loess fifteen feet beneath the surface, and from other stone implements described by Prof. Aughey, found imbedded in the Loess of Nebraska and Iowa, I think that but little doubt can remain that man existed upon the earth at the time this deposit took place.

Did he have an existence here prior to that time? There are many reasons rendering it probable that he had. Overlying the erie clay and underlying the recent drift deposit, and the Bluff formation in Ohio, Illinois, Iowa, Missouri, Kansas and other States, is an ancient "forest bed," with a soil from six inches to three feet in thickness. This ancient forest sprang up and had a vigorous existence in a climate not materially different from our present climate. The flora was not widely different from ours, and with a river drainage almost, if not entirely equal to our present drainage, there is no apparent reason why man should not have existed at the time. There was everything needful to supply his wants, and the condition in every way was such as to render his existence highly probable, or there was nothing at least to preclude the idea of his existence. Besides, the late Dr. Koch, in a paper submitted to the Academy of Science of St. Louis, claims to have found in Benton county, in this State, two arrow heads associated with the skeleton of the Missourium in a layer of vegetable mould, covered to the depth of twenty feet with alternate layers of sand, clay and gravel. One of the arrow heads lay underneath the thigh bone of the skeleton, the bone actually resting in contact upon it, so that it could not have been placed there after the deposit of the bone. The value of the claim of Dr.

Koch has been subsequently strengthened by the discoveries of Prof. Worthen in Illinois and by discoveries in California. This vegetable mould, no doubt, formed a part of the soil of the old forest bed. Did man then exist? The evidence seems to indicate that he did. If so, we must carry him back of the recent Drift and the Bluff formation to beyond the glacier period, and associate him with the mammoth and the mastodon.

I must not leave a gap so wide as that between man at the beginning of the Loess time and the first dawn of modern civilization at Kansas City, introduced by our Louis', and Philiberts, and Chouteaus, and Johnsons, and McGees, a little more than half a century ago. I have other evidences which will afford you glimpses of Man's presence here during this long intermediate interval of time. But how many races appeared and passed away from the scene is difficult to say, with the evidence now before us. Before the introduction of modern civilization, however, we have reason to believe that at least two races, differing in their habits and modes of life, were dwellers in our very fertile and picturesque hills and valleys.

I am indebted to Judge Ranson, of this city, for the information which led to the discovery of the specimens which I have the pleasure next to present you. The Judge superintended the widening of Twelfth street near its junction with Woodland avenue, in this city, several years ago, and in the excavation made for the purpose large quantities of flint chippings, arrow heads, stone axes and broken pottery were found at a depth varying from six inches to eighteen inches beneath the present surface.

The specimens taken out by him at the time, which amounted to the fourth of a bushel, unfortunately have been lost. One of them is described as being the half of a small pot or cup, capable of holding about a pint. This specimen had the appearance of being very recently broken, and was probably whole until the plow used in loosening up the earth for the excavation came in contact with it. I visited the place indicated the past summer, and was so fortunate as to find the specimens I have just presented you. The Osage Indians, I am informed by Mr. Johnson, occupied this place as a camping ground at the time of the first settlement of this country, and still used flint implements at this very recent time, so that we find flint chippings and arrow heads from the surface to a depth of about eighteen inches beneath. But we must not infer from this fact that they are all relics of the same race. For while the Osages used stone implements of the same style of art as those of earlier times, they knew nothing of the manufacture or use of the pottery we find lying in close proximity to them. It is difficult to say at what time these various deposits were made, or the number of different races associated with them. The flint implements seem to be of the same style of workmanship, all belonging to the paleolithic type; but the material used is widely different, while all of the specimens found at and near the surface are made from the common chert found in this vicinity, those of an earlier deposit, or many of them at least, have been fashioned from flint not belonging to this locality, nor within several hundred miles of here.

This latter class, or the material from which they have been made must have been transported from distant localities. There is yet another difference, that while the flint chippings and stone implements, including stone axes, have a wide range in this and the adjoining counties, buried at various depths near the surface, I am not aware that "prehistoric pottery" has been found except at this place, and in one place near the fair ground in Wyandotte county, Kansas. I am indebted to Mr. Winner, the efficient secretary of this academy, for information of this latter place. In company with him I recently made some researches there which resulted in our finding several fragments of pottery, in every way similar to that found in this county, which were, no doubt, deposited about the same time and by the same race of people. This latter array of specimens I also present for your examination. The earliest of the deposits, including the fragments of pottery and some stone axes of the neolithic type, may have been made soon after, or perhaps before, the completion of the bluff deposit. They are found resting almost, if not entirely, in contact with the upper surface of the Bluff deposit and imbedded in, or just beneath, the base of the vegetable mould overlying it. You will perceive from these fragments that there was at least two styles in construction, and as many as four different styles of ornamentation in the manufacture of the vessels of which these fragments are but the broken remains. One style of construction has a plain vertical rim at top about one inch in perpendicular height, from the base of which the bowl or body of the vessel gradually swells out in a convex form, terminating in an oval, diminishing downward, and perhaps slightly flattened at the base. The other style has simply a thickening or swelling out of the rim at top, and the bowl of the vessel is less convex than in the other. The ornamentation consists of indentations and punctures of various kinds upon the rim or around the base of the rim of the latter class; or it consists of engravings, traced before the hardening of the vessel, upon the outer surface, perhaps in imitation of a tree or plant. The vessels, judging from the curve of the broken pieces, would vary from one pint to several gallons in capacity.

The specimens I have described were found on a gradual slope of land, with but little elevation, reaching back from Jersey creek northwest, in Wyandotte county, and on a slope equally, but slightly, elevated, reaching back northwest from a branch of McGee creek, in this county.

So far as I know, artificial mounds have not been found in this vicinity, but farther investigation may disclose them.* In the meantime, with the evidence before us, we are not justified in assuming that the race that used and was associated with this pottery, was numerous or had a long existence here, for these relics are found, so far as I know, but at the two places indicated, and there confined to but very inconsiderable areas. * * *

* Since this paper was read, numerous mounds have been found in the vicinity of Kansas City, some of which have been described by Judge West.

THE EXCAVATIONS IN OLYMPIA.

There has been no flagging on the part of the Germans in their scientific investigations in the East, as witness her archæological researches in Asia Minor and Greece since 1871. The excavations in Olympia have opened a new era in the knowledge of the wonders of ancient Greece. Great and valuable riches have been dug up, and lately there has been a motion brought into the Imperial Parliament at Berlin for a new appropriation to continue these researches. To convince members of the importance of the work, the Government appointed Prof. Adler, who had been staying a long time in Olympia, to report to the Parliament what had been found at that place. The Professor says:

"The German Government had first to consider whether the undertaking would be of benefit to science, what would be the best way of carrying on the work, and the probable cost. After these and other questions of a secondary nature had been solved, the real business of excavation began October 4, 1875. The plain of Olympia is bounded on the west by the mountains of Druva; on the north is the woody Olympus chain, with the cone-like Kronos Hill standing out prominently, like one of nature's watch towers; on the south flows the many armed River Alpheios, and hurrying down from the north we have the brook Kladeos. The whole ground between Druva, Kronion and Alpheios, and far away into the Kladeos Valley is an alluvial soil of fine chalk and marl, with a slight admixture of clay which the Alpheios has spread over the plain in its headlong progress from the mountain lakes of Arcadia. The work at first did not progress so rapidly as it might have done, as the Greek Government were constructing a road from the place of excavation to the nearest harbor, and it was not till this was completed last year that our work could go on in peace. But in spite of this hindrance, casts of the treasures found were last year sent to twenty-seven art institutions, some in America and England. On the slope of the Zeus Hill were all the more important buildings, such as ten store-houses, several temples—among these the Temple of Zeus and two smaller ones in the same style, which when brought fully to the light of day will surely be found in good preservation, all with Doric columns; also ruins of brick erections, one a guard-room in which five men could stand. These latter are decidedly of the late Roman style.

"Alike in structure, and built of the same material as the brick ruins, are the sewers a little to the southwest of the temple. To the west of this is an ancient churchyard, a cemetery whose graves, formed of slabs of stone, have been many of them washed away by the Alpheios, and the arms of the warriors imbedded in the shallow shoals of the stream or in the wicker baskets of the fishermen. Since the discovery of these things the traffic which the fishermen of these coasts kept up in Greek bronze wares is accounted for, as also the presence of those articles in many art museums.

In the reports of 1875–6 there is a Byzantine church described as entirely covered with rubbish, partially excavated by the French, in 1829, and now completely bared to view. It was always thought that there lay a larger structure beneath, and this supposition is now confirmed. Besides a valuable treasure of well-preserved inscriptions and tombstones, there have been fonnd on this spot some ancient ruins of a chapel surrounded by a wall or court-yard. By digging further still eleven large statues came to light—the Emperor Marcus Aurelius, his wife and daughter, the Emperor Commodus, and the family of the maker of these statues. We have by no means exhausted all that are there. Though they are only statues originated in the second century, and of no great worth as works of art, still they are interesting as portraits of Roman sovereigns, enabling us to learn much and to surmise more. But the grandest discovery of all is the Temple of Zeus, which in our wildest dreams we never hoped to find as perfect as it has shown itself. We see from the traces of charcoal that the temple was partially burned, and afterwards injured more or less by repeated shocks of earthquake. Even in the Christian age people had their dwellings round about it, but were driven away by earthquakes. Greeks and uncivilized tribes, probably Avars and Slaves, broke the sculptures to pieces and made their dwellings of them. The fall of the temple and the inundations of the River Alpheios, which did not occur merely in the spring, but lasted for ten or fifteen years, drove away these tribes, and the alluvial soil spread unmolested pretty equally over the whole upper surface. After the territory had been deserted for a while a second swarm of inhabitants settled there, of whom we know nothing except that they were even of a lower grade than the first, for their abodes were more miserable and more primitive than those over which they built. The reason that the first discoveries went on so slowly was because we deemed that the interests of science required us to preserve these ancient dwelling houses intact. But when we were sure that statutes lay beneath, short work was made of the housee, and the treasure below lay revealed.

One interesting discovery was the learning the name of the architect, Libon, and another the year of the erection—431. It is undoubtedly the most beautiful of all Doric temples known. It represents the last and best age of the heavy, bulky erections, as they were known in Sicily, while the more elegant ones were to be found in Athens. The material used in its construction was not a good sort—a kind of shell lime, done over with two thin layers of stucco, which was then painted. The interior arrangements are exactly as Pausanias and others describe them. Pausanias relates that the temple was adorned with sculpture. The twelve labors of Hercules were introduced, six over the principal door and six at the back. He further tells us that the two tympanums represent the last quiet quarter of an hour before the race of Pelops and the father of Hippodamia, the first-named winning by his cunning the four-horse race. The order in which the figures come, and their number, he likewise enumerates—Zeus in the center, then Pelops, Hippodamia, Kilias, the four horses abreast, the grooms (hippokrome), and last the river god Alpheios, under the figure of a man reclining to the right of Zeus, Oinamaos, Aerophe, Myrillos, again the four horses with two hippokromes, and the river god Kladeos. In this way Pausantas recapitulates twenty-one figures, viz: thirteen men and eight horses; and all these have been found, not perfect, it is true, but of each one some piece or other. Unfortunately, as yet only six heads have been excavated—three men's and three horses'. The reconstruction of the sculptures has been begun with great care, and it is pretty correctly ascertained to whom each separate little piece belongs. The lecturer was of opinion that the tympanum would have appeared to bare with only twenty-one figures, and doubts not that some accessory figures will turn up. Zeus, Pelops and Hippodamia have been found in tolerably large fragments. The discovery of the steeds tells us plainly how advanced the Greeks were in the technical parts of their subjects, and in perspective. The four horses abreast could not be allowed to occupy more space than a meter. The artist had depicted three in the back-ground in alto-relievo, close together, but the fourth, in advance, stands alone; and yet the group, as seen from below, has the effect of four horses close together, but free. The second tympanum, by Alkamenes, the pupil of Phidias, is in a much better state of preservation than the first. Only eleven heads, however, are forthcoming, which Mr. Newton declares to be the most beautiful and genuine of all we have of the Phidias school. The picture on the pediment is the moment when the Centaurs, heated with wine, begin to attack the Grecian women and virgins sitting near them. Of this west tympanum twenty-six different figures have been found in all. Thus the two tympana alone contain from forty to forty-four figures, undoubtedly of Greek origin, a colossal endowment to science, when we reflect that, of the 7,000 or 8,000 statues in Rome, not more than from 3,000 to 4,000 are genuine Greek work. Paris, London and Athens have few, indeed, to show. As regards the execution of these figures, we are too much accustomed to test all the Greek statues by what Phidias has done. The figures we have here are undoubtedly the work of great masters; but, as they were intended for particular niches, the side invisible to the spectator was left incomplete, while Phidias always worked up even those portions not exposed to view in the most painfully exact manner. All these statues gain immeasurably by being seen from the right height and light. Grecian art is only thus comprehensible in all its grandeur.

Then we have among our discoveries from five to twelve most excellent Metopes. Pausanlas mentions particularly the Atlas-Metope, which will come out in all its wonderful beauty as soon as the second cast of it has been completed. One of the first objects dug out was a Nike of Paionios, unquestionably the most complete piece of statuary yet found. It is the more interesting from having an inscription on it informing us of the name of the sculptor, and of the fact that his work carried off the prize from all other competitors. This Nike must have been placed here some fifteen years before the temple was built. Even the French acknowledge that since the Venus of Milo nothing to equal it has been found. Moreover we have several bronzes, such as remains of tripods, coins, weapons. Of bronze statuettes there is only one large one. Still our bronzes amount to 1,000 or more, but mostly small pieces. Of these we may mention a bull's ear and horn the size of life, one of a lion in bronze relievo, statuettes of warriors, different bronze animals scarcely distinguishable—such as horses, swine. cows, etc., probably consecrated gifts from the pooorer inhabitants of the country in good harvest years. Among them, too, we have a griffin's or peacock's head in bronze. As duplicates of anything have to be divided between the Greek and German Governments, the Germans will certainly not get many of this collection. Numerous articles in terra cotta display rare perfection in form, preparation, and color, and lead to the supposition that the ancients must have well understood brick-making and burning."—*Globe-Democrat.*

THE NOTABLE ANTIQUITIES OF THE UNITED STATES.

Archæology is certainly on the advance. The recent researches abroad —at Cyprus, Mycenæ, Bologna ; in short all over the earth—are stimulating inquiry and investigation nearer home, and the prospect is that we shall have something to interest us in our own prehistoric antiquities. The learned world hail with delight the wonderful discoveries of Di Cesnola. Schliemann, George Smith Wood, and other earnest explorers in the East, and the hope is that we are about to see active scientific interest directed towards our own archæology. All most certainly rejoice in the prospect of scientific progress in our land. The antiquities of America have been most singularly overlooked and neglected. For years the efforts of active investigators have been directed towards the development of our vast and almost wholly unexplored archaic field. The government has been solicited, Congress invoked, learned societies appealed to; but all in vain. Our people, ever ready to interest themselves in the antiquities of other lands, had but few words of encouragement for home explorers. Ample means could be raised, if necessary, in response to a cable telegram, to secure foreign antiquities, but not one dollar to purchase relics of the great unrecorded age —of that lost civilization which once filled the great valleys of the West. These facts are discreditable to our age, our people, and the government.

These reflections are due to the meeting of scientists in Boston recently to consider the importance of securing for Boston and the country the celebrated Dighton Rock, which has so long divided the attention of scientific men. It appears that the rock in question is in danger of being carried off by the King of Denmark, under some show of title conveyed years ago to the Royal Society of Northern Antiquities, Copenhagen. To prevent this, many of leading citizens of Massachusetts have concluded to initiate a movement as above indicated. Among those interested are President Eliot, of

Harvard, Prof. Longfellow, Gov. Rice, Mayor Cobb, Thomas G. Appleton, John G. Whittier, James Russell Lowell, Rev. Dr. Vinton and Dr. Green.

What is the Dighton Rock? It is a huge granite mass lying on the east side of Taunton River, at Dighton, Mass., bearing an inscription in certain characters which have perplexed antiquarians and novices since 1680. A popular fallacy ascribes the inscription to adventurous Norsemen, who, about the year 1000 of the Christian era, visited the coast and have left the impress of their names and deeds, as it is claimed, at various points. This inscription has been variously pronounced Runic, Phœnician, Indian, etc. Copies were sent to the learned secretary of the society at Copenhagen, the late Prof. Rafn, who pronounced it: ("Antiquitates Americanæ") a Runic inscription dated back to the tenth century. Prof. Rafn appears to have been misled by the misquotation of certain characters—O R I N X—representing, as alleged, the name of one of the early Norsemen who navigated the waters about Martha's Vineyard.

A Phœnician origin has also been ascribed to "Writing Rock," as a monument of the earliest navigators of the remarkable maritime people who had passed the the Pillars of Hercules, claiming that the "pillars" occur among the sculptures on the rock. Notwithstanding all these diverse opinions of foreign savans and home archæologists, the true solution of the enigmatical inscription doubtless lies in the interpretation given by the late Mr. Schoolcraft, who construed the principal characters to be Indian, or more properly of an indigenous race—whether red men or some transitory type may not be determined. Rock inscriptions are not rare. They occur all over the country, from fartherest Main to the confines of our Western plains. They can not be traced to the same sources; many are due to the North American Indian, while others have a much greater antiquity. Recording upon stone is of very high antiquity. Ancient inscriptions are found all over the East.

Recurring to Dighton Rock, Mr. Schoolcraft, under the guide of Chingwaak, an Indian Chief, made it Muz-zin-na-bik, or rock writing of the Wabematais. The record denotes a battle, and was made by the victorious party. Washington, it has been stated, expressed the opinion while at Cambridge, 1789, that inscription was Indian. He had doubtless examined rock sculpture along the upper Potomac, Monongahela, and elsewhere in Virginia, and was familiar with this style of "rock-writing."

We present for the purpose of comparison several specimens of so-called Indian pictographs found on rocks in various parts of the country. These are properly Muzzinnabiks, representing both their glyphs and pictographs. The simpler forms of pictography are shown upon grave-posts. Painting upon scrolls of birch bark, skins, etc., is called kekeewin, or instructions.

Thoroughout New England numerous specimens of rock-writing occur. Dr. Green at the Boston meeting referred to several. In the State of New York there are others that could be mentioned. Along the St. Lawrence some occur, and even amid the granite folds of the Adirondacks rock-sculpturing has been noticed. On the Susquehanna, near Lancaster, Pa., "Indian Rock" is a famous locality. There are two—"Big and Little." The somewhat celebrated "Pompey" or "Oneida Stone," discovered in Onondago county, N. Y., is an object of antiquarian interest, but not of Indain or prehistoric origin. It is a gneissoid bowlder, 12 by 14 inches, and 8 in thickness.

Near Barnesville, O., are interesting rock sculptures. The location is near the line of the Central Ohio Railroad, west of Barnesville. Two massive sand rocks lie near the summit of a hill, and measure about ten by fourteen feet. Their exposed surfaces bear elaborate sculpturing. The work is *intaglio*, corresponding to this class of rock sculptures throughout the West.

Nearly opposite Buffington Island, in the Ohio, on the Virginia shore, may be seen at the low water an extensive rocky surface, bearing rude representations of animals, reptiles, birds, etc., including man himself. Of the reptiles well depicted is a saurian over ten feet in length. The power of the aboriginal sculptor has been elaborately displayed on this extensive rocky surface—one of the most interesting I have examined in the West.

"Antiquity," a few miles below, is the site of another sculptured rock which early attracted the attention of boatmen. Flood and vandalism have quite effaced most of the characters. On the Guayandotte, Great Kanawha, Sandy, and elsewhere in West Virginia, Kentucky and Ohio and are interesting sculptured rocks. To describe all would require a volume. Throughout the great West and Southwest we find sculptured rocks, on mountain, plain and estuary. There is a fine one in Georgia. It occurs on a granite bowlder, the characters being well cut. Passing to the far west are some rock carvings discovered on the face of a bold, lofty escarpment of coarse-grained sand rock, over 100 feet in height, on the Upper Missouri. About half way up are animals, symbols, pipes, implements, etc.

Recent explorations of the vast inter-mountain region of Colorado, Arizona, etc., have resulted in the discovery of interesting sculptured rocks in that part of our great domain.—*New York Graphic.*

UTAH MOUNDS.

We are kindly permitted, by a gentleman from this place, to make public the following interesting letter from a friend at Payson, Utah Territory:

SIR:—Your letter requesting me to furnish you information and a description of the Payson mounds, and the late discoveries made therein, I have received, and I herewith forward to you such knowledge of these ancient mounds as I possess. The mounds are situate on what is known as the Payson Farm, and are six in number, covering about twenty acres of ground. They are from ten to eighteen feet in height, and from 500 to 1,000 feet in circumference. For years farming was conducted on the land, and fields of grain were planted, grew and were harvested to the very base of the homes of the mound-builders, the busy hard-working toilers of the field apparently caring little how or when they came here. About two years ago several of the residents whose curiosity had been arrested regarding the mounds concluded to explore their interior to see what could be found in the way of relics, and, perhaps, to find the glittering treasure that several spiritual mediums had said was hidden in one of the mounds. The explorations divulged no hidden treasure so far, but have proved to us that there once undoubtedly existed here a more enlightened race of human beings than that of the Indian who inhabited this country, and whose records have been traced back hundreds of years.

Last year, while engaged in excavating one of the larger mounds, we discovered the feet of a large skeleton, and carefully removing the hardened earth in which it was embedded, we succeded in unearthing an entire skeleton without injury. The human frame-work measured six feet six inches in length, and, from appearances, it was undoubtedly of the male gender. In the right hand was a huge iron or steel weapon, which had been buried with the body, but which crumbled to pieces on handling. Near the skeleton we also found pieces of cedar wood, cut in various fantastic shapes, and in a perfect state of preservation, the carving showing that the people of this unknown race were acquainted with the use of edged tools. We also found a large stone pipe, the stem of which was inserted between the teeth of the skeleton. The bowl of the pipe weighs five ounces, made of sandstone, and the aperture for the tobacco had the appearance of being drilled out. The inhabitants here say a race of people existed here 1,400 years ago, and belonged to a tribe known as the Nephites, who are often referred to in the Book of Mormons, which also speaks of terrible encounters these people had with their ancient enemy, the Lamonites. We found another skeleton near that of the above mentioned, which was not quite as large, and must be that of a woman. There was a neatly carved tombstone at the head of this skeleton. Close by the floor was covered with a hard cement, to all appearances a part of the solid rock, which after patient labor and exhaustive work we succeeded in penetrating, and found it was but the corner of a box similarly constructed, in which we found about three pints of wheat kernels, most of which dissolved when brought in contact with the air. A few of the kernels found in the center of the heap looked bright, and retained their freshness on being exposed. These were carefully preserved, and last spring planted and grew nicely, though the field insects seemed determined to devour it. We raised four and a half pounds of heads from these grains. The wheat is unlike any other raised in this country, and produces a large yield. It is of the club variety—the heads are very long, and hold very large grains.

We have found many curiosities in the mounds belonging to this ancient race once inhabiting this section. We find houses in all the mounds, the rooms of which are as perfect as the day they were built. All the apartments are nicely plastered, some in white, others in a red color; crockeryware, cooking utensils, vases—many of a pattern similar to the present age —are also found. Upon one large stone jug or vase can be traced a perfect delineation of the mountains near here for a distance of twenty miles. We have found several mill-stones used in grinding corn and plenty of charred corncobs, with kernels not unlike what we know as yellow dent corn. We judge from our observations that these ancient dwellers of our country followed agriculture for a livelihood, and had many of the arts and sciences known to us, as we found molds made of clay for casting of different implements, needles made of deer horns, and lasts made of stone, and which were in good shape. We also find many trinkets, such as white stone beads and marbles, as good as made now; also small squares of polished stones resembling dominoes, but for what use intended we can not determine. I have endeavored to give you a full description of the explorations so far, and as we continue will keep you informed.—Amasa Potter, *in Eureka (Nev.) Sentinel.*

THE FAMOUS MOABITE STONE.

In the same room with Alfred Vicker's pictures is a very clever reproduction, by a lady, of the famous Moabite Stone, which was discovered in 1869. The original, it will be remembered, was found at Dhiban by Rev. F. A. Klein, a French clergyman, employed by the English Mission, in the possession of the Brue Hamajdah, one of the wildest Arab tribes, who had long kept it with great jealousy as being possessed of supernatural powers. All attempts to purchase the stone through native agents failed, and even the appeal to the Sultan did not suffice to give possession of it. In the end the Arabs, fearing that they should be deprived of it, determined to destroy it, and this they attempted to do by first heating it by a fire lit underneath it, and then, when it was red hot, throwing suddenly cold water over it. It was in this way effectually broken into pieces. But, fortunately, M. Clermont Ganneau, the learned philologist and now Professor at the Sorbonne, in Paris, had succeeded in taking what is called "a squeeze" or clay impression from the face of the stone, and after it was broken Capt. Warren, of the Palestine Exploration Expedition, took squeezes of the two larger fragments. The stone in fragments was eventually secured for the French Government, and after great care the recovered fragments were put together and the restored tablet now remains preserved in the Louvre at Paris. It measures four feet one inch in breadth, having an arched top and squared base, and being about ten inches in thickness. The model now exhibited is made to a scale of a quarter the size of the original, and evidently with the greatest accuracy that skill and patience could exert. The letters have each one been copied faithfully, and all the joinings of the fragments, where they show at all, so that we have before us in a portable form this priceless and most interesting relic. The letters are in straight lines across the face of the stone, and they are considered by the authorities in these abstruse questions of paleography to be in the same characters as those used by David in the Psalms and by Solomon in his correspondence with Hiram, King of Tyre. To give some idea of the form of these letters, it may be said that they resemble rather our ordinary Arabic numerals, letters like the 6, 7, 4 and 0 occurring frequently, and others like our Roman Y and P. They are all incised, and appear to have been cut in by some hard and sharp tool. As to the date assigned to this record, which has been all read and translated by M. Clermont Ganneau, it has been confidently stated by the Count de Vogue to have been engraved in the second year of Abaz, King of Isreal. It is, therefore, older than the Homeric poems, as we know them through Homer, at least, and older than the famous inscription of Ashmunazar, probably 900 B. C. Although certain discrepancies remain to be cleared up, no doubt is felt as to general tenor of the inscription. A translation has been published, and may be obtained of the Palesine Exploration Society, and we presume, also, that copies of this excellent model may be obtained by those interested in this subject. At any rate, too much cannot be said in commendation of the great skill and patience devoted to this copy of the famous stone.—*London Times.*

INDIAN RELICS AT DAVENPORT, IOWA.

The Indian relics discovered by the Rev. J. Gass in a mound near Davenport, Iowa, continue to evoke discussion. They consist of tablets of dark colored slate, with pictorial engravings, one of which represents a funeral pyre or a sacrifice, around which a dance is taking place; twenty-two stars and the sun and moon are also shown, and there are two lines of a written language in unknown characters. On the reverse of the tablet, which is rather less than a foot square and about one and a half inches thick, there are sketches of men, several quadrupeds (including two mastodons), some birds and trees. Another tablet has a dial, with four concentric circles, within which are marked the four cardinal points and twelve equidistant characters supposed to represent the signs of the zodiac. There is no doubt that these relics were found along with human remains, among layers of shell, in a mound. If put there for the purpose of imposture, they have been skillfully placed. All authorities agree that if the relics are genuine they are by far the most important archæological treasures yet found in this country.

MINERALOGY.

BITUMEN, ASPHALTUM, PETROLEUM, PYROSCHISTS AND CERTAIN OTHER SOLID HYDRO-CARBONS.

BY G. C. BROADHEAD, OF PLEASANT HILL, MO., LATE STATE GEOLOGIST.

[Read before the Kansas City Academy of Science, Nov. 28, 1876.]

In 1876 I was appointed as one of the judges of the Centennial Exhibition at Philadelphia, and as such I was assigned to write up a part of the exhibition, including the substances named at the head of this article. That article is included in the following pages, with but few additions and changes.

HYDRO-CARBONS

May be thus classified:

1. Gaseous hydro-carbons—Marsh gas, olefiant gas.
2. Thin oily hydro-carbons, as petroleum.
3. Thick oily hydro-carbons—Maltha or mineral tar, pittasphalt.
4. Solid Hydro-carbons, as asphalt, or pitch.
5. Cannel coal and pryoschists, or slate.
6. Bituminous coal.

BITUMEN—ITS EARLY HISTORY.

Anciently, far back in the remote uncertainty of time, we find that in the building of the tower of Babel "Slime had they for mortar,"* that the ark of Noah was coated within and without with pitch,† and we are further told in sacred writ "that the mother of Moses took for him an ark of bulrushes and daubed it with slime and with pitch."‡ In the latter instance the pitch was undoubtedly bitumen; in the others we infer that bitumen was also used, and there is no doubt of its being used in the construction of the tower of Babel.

Herodotus|| informs us that the walls of Babylon were of brick laid in bitumen. It was heated and used as a cement in the place of mortar, and he also says that they mixed it with the tops of reeds and it was placed between every thirtieth course of bricks. His statements have mostly been confirmed by the observations of later travelers. Some state that they have found that bitumen was used in every seventh or eighth course, and at one place it was even found between every course of brick. Two kinds of brick appear to have been used at Babylon, one fire-baked, and the other sun-baked. Some were deposited in lime and sand, or only in clay, others in bitumen. Brick from Hillah, with bitumen still adhering to one side, were examined by Parkinson, and the bitumen was found to be still combustible and would

* Gen. xi, 3. † Gen. vi, 14. ‡ Ex. ii, 3. || Clio. Book, I.

burn when brought into the flame of a candle, yielding a strong bituminous odor.* The village of Hillah, or Hellah, is said to occupy the site of the ancient tower of Babel, and the city of Babylon must have been on or near the present site of Hillah, which is known to have been built of the brick of the ancient city, and even may have been built upon the very site of ancient Babylon.† The bricks examined by Parkinson must therefore have been at least 3,500, or perhaps even 4,000 years old.

Bitumen flows out of the ground at Babylon. It is also dug up in Syria, but that used at Babylon was obtained at Hit, or It, or on the river Is, of Herodotus' eight day journey above Babylon.

Bitumen was also much used in building at other places. The wall of Media, between the Euphrates and Tigris, was built of burnt brick, laid in bitumen. We are also informed that the Persians would dip their arrows in pitch, light them and shoot on to the roofs of their enemies.‡

The Dead Sea, or Lake Asphaltites, is mentioned by most of the ancient writers as being very bituminous, and Diodorus states that near its middle a mass of bitumen would rise up every year and float off, appearing in the the distance like an island. This was gathered by the neighboring people, who carried it to Egypt and there sold it to the Egyptians, who used it in embalming their dead. In modern times the Arabs procure this bitumen from the shores of the Dead Sea and sell it at distant places.

Bitumen is spoken of by some of the ancient writers as pissasphaltum, and at Agrigentum it was burned in lamps in place of oil and called Sicilian oil.

PETROLEUM—ITS EARLY HISTORY.

Mr. Wm. Buck, Curator of Records of Pennsylvania Historical Society in an interesting article read before the society March 13, 1876, states that "the early French missionaries knew of its existence as early as 1627," and Charlevoix mentions that "in 1642 the Jesuits found near Lake Erie a thick oily stagnant water, which, on application of fire, would burn like brandy." Messrs. Dollier and Gallinee, missionaries of the order of St. Sulspice, prepared a map of the country in 1670, on which there is marked Fontaine de Bitumie, about where is now the town of Cuba, Allegheny county, New York. Charlevoix, who traveled through the country in 1721, mentions this water, which resembled oil and had a taste of iron. He also names another fountain containing similar water used by the savages to appease all manner of pains. Sir Wm. Johnson, who visited this region in 1767, mentions the fact of oil being upon the water, and *Spofford's Gazette*, May, 1822, mentions the Seneca oil spring at Cuba, N. Y. This spring is on a reservation of one mile square, belonging to the Seneca Indians, and the oil has been long known as Seneca oil. The earliest mention of petroleum in Pennsylvania was by Charlevoix, who obtained his information from De

* Parkinson, Organic Remains of a Former World. †Ib. Also Eng. Cycl., Nat. His. and Moore's Anc't. Min. ‡Parkinson, Organic Remains.

Joncaire in 1721. Fort Duquesne was built in 1754; the commandant, soon after, in writing to Montcalm, speaks of observing astonishing wonders about three miles above Fort Venango, where he witnessed a religious ceremony of the Senecas. The tribe appeared very solemn, the great chief recited the conquests and heroism of his ancestors; the surface of the stream was observed to be covered with a thick scum, which at once burst into a complete conflagration. The oil had been gathered and lighted with a torch. At sight of the flames the Indians gave a triumphant shout.

Lewis Evans, a surveyor employed by the Proprietary of Pennsylvania to take geographical observations, in 1755, published a map which has "petroleum" marked thereon, near the mouth of the present Oil creek, on the Allegheny river.

David Zeisberger, a Moravian missionary, who visited the country of the Allegheny river in 1767, speaking of the oil springs, says, "that the Indians would dip off the surface oil, then stir the well, and when the water has settled, fill their kettles and purify the oil by boiling." He informs us that it was used by the Indians for toothache, headache, swellings, rheumatism and sprains, was of a brown color and could be used in lamps, and that it burned well.

Gen. Benj. Lincoln, in 1783, mentions the oil springs on Oil creek, Penn., and says, "that the soldiers bathed their joints with it and it afforded relief and freed them from rheumatic complaints; also that water impregnated with it operated as a gentle purge."

The proprietors of the *Columbian Magazine*, in 1787, published a map of Pennsylvania on which petroleum was marked near the confluence of Oil creek and the Allegheny. Since that time there has been frequent mention of Oil creek and the oil of this vicinity. Gideon C. Forsyth, in 1808, first mentions the occurrence of Seneca oil in Ohio, and Dr. S. P. Hildreth, in 1809, mentions its occurrence in the Muskingum valley. Gen. Lincoln, in 1783, speaks of a burning spring in Western Virginia, near which certain huntsmen had once camped, who, taking a brand to light them to the spring, a few coals were dropped upon the water and in a moment the water was in a flame, so that they could roast their meat as well as upon a hot fire.

Bituminous and burning springs were also mentioned by Thomas Jefferson and others as occurring on the Great Kanawha.

Near Scottsville, Ky., in early days, an oil (petroleum) was collected from springs and used for lighting purposes, and the Pittsburgh *Gazette*, in 1828, suggested that the city be lighted with petroleum.

On Oil creek, Pa., there are found old pits, cribbed in with timber, in which trees of several centuries growth are found, giving evidence of the ancient use of the oil. For many years the entire supply of naptha was obtained from the surface of these oil springs, and as late as 1859 Seneca oil was obtained in this way.*

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*Wm. Buck.

The area over which petroleum has been found in the Eastern United States extends parallel with the Appalachians from New York to Tennessee, with an area of 3,115 square miles, of which only 39½ miles have produced oil in Pennsylvania.*

The best known and most prolific oil springs have been found on Oil creek, Venango county, Penn., and here, in 1859, were the first borings for oil. At 71 feet the first crevice was reached, and at 200 feet the second sandstone was passed through. In 1861, at 400 feet depth, the third sandstone was passed through, yielding oil. The Phillips well at that time flowed 3,000 barrels of oil per day, and soon after the Empire had the same flow.†

Salt was the precursor of the discovery of most of the oil wells. Numerous wells were sunk on Oil creek and vicinity, and the yield of oil became very great. The consumption was not equal to the supply and it sold at one time at ten cents a barrel. In 1861 it sold at twenty-five cents per barrel.

In 1864 the production had declined to 4,000 barrels per day and the highest price paid was fourteen dollars per barrel.‡

Prof. J. P. Lesley, in 1874, published an oil map, on which the following named oil regions are marked: The extreme northern in Kent, Bothwell and Lambion counties in Canada. Next commencing in Cataraugus county, New York, extending through McKean, Warren, Venango, Butler, Lawrence, Allegheny, Beaver, and terminating in Columbiana, Jefferson and Hancock counties, Ohio. A little further south an area includes portions of Noble and Washington counties, Ohio, with Wood, Pleasants and Ritchie counties, West Virginia. Another area includes portions of Perry, Athens and Meigs counties, Ohio. Then, at a long interval southwest, we encounter an oil district including portions of Allen, Wayne, Clinton, Barren, Adair, Cumberland and Monroe counties, Kentucky, with Overton county, Tennessee.

GEOLOGY OF THE PETROLEUM OF THE UNITED STATES AND CANADA.

We learn from the Canada geological report for 1863 that in Canada hydro-carbonaceous matter, probably derived from organic remains, is found from the base of the palæozoic rocks up, and in many instances it assumes the form of bitumen. Its presence is evident in the limestones and dolomites of the Quebec group and Trenton group, and in most of the palæozoic rocks. At Pakenham the large orthoceratites of the Trenton limestone sometimes hold several ounces of bitumen in their cavities, and at Montmorenci petroleum exudes in drops from the corals of the Birdseye limestone, but it is more abundant in the higher formations. The dolomites of the Niagara group, in the western basin, are more or less bituminous, and in parts of Western New York the limestones are so bituminous that when heated the bitumen is seen to exude from them.

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*2d Geol. Surv. Pa., J., p. 1 and Seq., 1874. †Ib. ‡2d Geol. Surv. Pa., J., 1874.

Those of the corniferous are still more bituminous. Many fossils, chiefly of the genus Heliophyllum, are surrounded and their cells filled with bitumen. In some localities the bitumen is solid and assumes the form of asphaltum or mineral pitch.

According to Prof. James Hall, mineral oil is found in the septaria of the higher Devonian beds and also in the underlying sandstone of the Portage and Chemung group. The oil wells of Pennsylvania and Ohio are extended into the sandstones, but it is even probable that the oil may originate in the Cornifierous below. Prof. Newberry thinks the oil of Ohio and Kentucky is derived from Huron shales (Portage) at top of the Devonian, and that some of the Pennsylvania oil wells derive their supply from the same horizon. The wells of Western Canada, according to the Canadian geologists, issue from the Corniferous formation. At Enniskillen the borings extend 200 to 300 feet in the overlying Chemung and Hamilton shales, which have also 40 to 60 feet of clay and gravel upon them. The surrounding country here is generally level, and near Petrolia the overlying clay has a nearly uniform depth of 100 feet, beneath which the borings penetrate an average thickness of 380 feet of interstratified blue clay, dolomite, shales and marls of Hamilton and Chemung to the oil producing stratum. The theory is that the oil originates in limestones and is retained in a reservoir formed of the overlying sandstone.*

The petroleum of Athabasca and the northwest territory of British America occurs in Devonian shales and in large quantities.

On Oil creek, Pa., the chief oil producing rock is a third sandrock below the surface, and an oil producing spot in the Pennsylvania regions is an area overlying, from 500 to 1,500 feet, a bed of porous conglomerate from 3 to 75 feet in thickness, the thickest portion of the rock giving the best well, and the thickness is generally found in the center of the area, the rock tapering to the edges. The rock is considered the third sandrock, but we learn that it is not always continuous, but that there do exist detached beds of lens-shaped masses of third sandrock. This sandstone has been passed through at its greatest known depth, at 1,976, feet, and appears to be a white pebble conglomerate containing some green oil. In the same well (Jonathan Watson's) the next highest sandrock was at 1,507 feet, and was considered the true third sandrock.†

Prof. Lesley says that the Pennsylvania oils are not entirely confined to three oil sands, but extend through at least 3,000 feet of measures.

There are three chief oil sandrocks, all below the carboniferous strata. Some of the flowing wells have been penetrated to these lower sandrocks, and Prof. Lesley also says that the Canada oil bearing rocks pass under Lake Erie and are far below the Pennsylvania oil sands of the Allegheny river country.‡

The surface rocks of the oil wells of West Virginia are sunk in Carboniferous strata, but some of the oil is probably from below.

* Canada Geological Report, 1863. † Penn. Geol. Rep., J., 1874. ‡ Ib.

The black slates (Huron) of the upper Devonian of Ohio and Kentucky, according to Dr. Newberry, abound in hydrocarbonaceous matter and are undoubtedly the source of the oil supply.

STATISTICS OF PETROLEUM.

In Canada there are four areas, in which natural oil springs are found, two in Enniskillen, a third in Mosa and Oxford townships, and a fourth in Tilsonburgh. At the former wells have been sunk with great success. Near Oil creek, in Enniskillen, the thickened oil forms deposits known as gum beds of viscid, tarry consistency, and covering two or three acres of two inches to two feet in thickness. At Petrolia a bed of solid asphaltum two to four inches thick was found at ten feet depth in the clay, and sometimes hardened bitumen is found in cavities of the rock.

At Enniskillen the larger supply has been obtained from the deeper wells, and from some petroleum has risen above the surface of the earth. A well 200 feet deep yielded 2,000 barrels in twenty-four hours. Both oil and water flow out, and in some of the deeper it is saline. The oil area of Enniskillen covers about four square miles. The total oil producing area of Petrolia and Enniskillen is eleven square miles.* From a catalogue of Canada minerals, 1876, arranged for the Philadelphia exhibition, we learn that the borings in Enniskillen average 480 feet. At first the oil flowed spontaneously, but now the wells require pumping. There are at present 300 wells capable of producing petroleum, but only 200 are in operation, with between 200 and 300 steam engines used for pumping and boring. Only a small portion of the oil is distilled at Petrolia, but the greater part is refined at London, fifty miles east. At this place are fifteen refineries, with a total capacity of 12,000 to 15,000 barrels per week. The principal oil works here are the Atlantic Petroleum works, with Waterman Bros. proprietors. Their exhibition in the Canada section, Main building, Centennial, Philadelphia, was large and creditable. The catalogue of the Canada exhibit at the Centennial gives the amount of oil shipped from Enniskillen for the year ending January, 1863, at 82,814 barrels, of 40 gallons each, and the quantity refined in Ontario for the year ending June 30, 1871, 269,395 barrels; year ending June 30, 1872, 308,100 barrels; year ending June 30, 1873, 365,052 barrels; year ending June 30, 1874, 168,807 barrels; year ending June 30, 1875, about 210,000 barrels. The greater portion has recently been consumed in the dominion.

* Canada Geol. Rep., 1863.

H. E. Wrigley* furnishes the following statistics of production in the Pennsylvania oil regions:

Year.	Product in Barrels.	Average price per Year.	Amount in Dollars.	Barrels crude Exported.	Crude value of Export at Well.
1859	3,200	per gal. 31	$ 41,614		
1860	650,000	" 16	4,368,000		
1861	2,113,000	"bbl $2 73	5,770,128	27,812	$ 75,926
1862	3,056,006	1 68	5,135,098	272,192	457,282
1863	2,611,359	3 99	10,419,322	706,268	2,818,009
1864	2,116,182	9 66	20,442,318	796 824	7,697,319
1865	3,497,712	6 57	22,979,967	745,138	4,895,556
1866	3,597,527	3 73	13,418,775	1,685,761	6,287,888
1867	3,347,306	3 18	10,644,433	1,676,300	5,330,634
1868	3,715,741	4 15	15,420,325	2,429,498	10,082,416
1869	4,215,000	5 85	24,651,750	2,568,713	15,026,971
1870	5,659,000	3 80	21,504,200	3,530,068	13,414,258
1871	5,795,000	4 35	25,208,250	3,890,326	16 922,918
1872	6,539,103	3 75	24,521,636	4,276,110	16 037,475
1873	9,879,455	1 84	18,173,197	4,981,441	9,165,851
1874	10,910,303	1 17	12,765,054	4,903,970	5,737,644
	67,707,094	av. $3 48	$ 235 475,120	32,490,971	113,950,156

The *Engineering and Mining Journal* gives as follows: In 1875, 8,787,506 barrels produced; 1876, 5,023,351 barrels produced, (estimated).

In the Pennsylvania oil region there were drilled in 1869, 991 wells; in 1870, 1,007; in 1871, 946; in 1872, 1,032; in 1873, 530; in 1874, 433. Total drilled from 1869 to 1874, inclusive, 4,939, or in round numbers 5,000, producing 42,000,000. The average life of these wells is two and a half years.* On January 1, 1876, there were 3,314 oil producing wells in Pennsylvania.†

OTHER LOCALITIES OF OIL AND BITUMEN.

Ten years ago petroleum was known to exist in California, but only recently was it thought to exist in large quantities. But it is only found largely in the region of Lespe and San Fernando. The two districts of San Fernando and San Buenaventura are about fifty miles square. The San Fernando district is in the northwest part of Los Angelos county, lying on the foot hills and northeast slope of the San Gabriel mountains. The main belt of oil bearing shale can be readily traced in a width of 400 to 500 feet for about six miles northwest and southeast, between walls of sandstone, dipping southwest 32°. There are numerous wells, but the district as yet contains only one flowing well, yielding forty barrels daily. There is one refinery, which produces from the crude petroleum 60 per cent. of illuminating oil of 120° to 130° fire test, and 25 per cent. of fine-grained lubricating oil, the remaining 15 per cent. being fuel.

The district of San Buenaventura lies west of San Fernando and forty miles from Los Angelos and adjacent to the sea. It contains large petroleum springs, the oil of which floats off to the sea. The district has a re-

* Penn. Geol. Rep., J., 1874. † Eng. and Min. Journal.

finery, producing from crude 59 per cent. of illuminating oil of 130° fire test.*

Petroleum is found also in Asia Minor, Persia, Hindostan, Japan, and some portions of South America.

In New Zealand petroleum is obtained from Waipawa, Poverty Bay, Province of Auckland on the west coast, and Waipu, east coast. It escapes through cracks in trachyte breccia at Sugar Loaf Point, Taranaki. Wells have been bored several hundred feet deep but no steady supply obtained. Oil from this place was on exhibition at Philadelphia in the New Zealand section. The distilled oil has a specific gravity of 0.874 to 0.941. It is therefore not adapted for kerosene, which has a specific gravity of 0.810 to 0.820. The crude oil, of specific gravity .872 of 58° Fahrenheit, yields when distilled fine lamp oil 11.2 per cent., specific gravity .82. Inferior oil 37.75 per cent., specific gracity .858. Lubricating, 25.69 per cent. Paraffin 16 per cent. Bituminous residue 9.36.

OIL IN WESTERN MISSOURI.

Bitumen occurs in Western Missouri from Ray to Newton county, a distance of 175 miles north and south, and over a width of 25 to 35 miles, the rocks of the southern half being much saturated with it. From Bates county southwardly and extending westwardly into Kansas, tar springs are frequent. Although the rocks are often quite black with tar, and drops are seen oozing out and pools of liquid bitumen are sometimes found, still the quantity does not seem to be concentrated in sufficient quantities at any place to pay for the working. Its mere presence has occasioned the sinking of several deep wells, with no profitable results. There exists no positive anticlinals nor sinclinals in this district as there are in Pennsylvania, hence there is no room for basins for collecting the oil. Its greatest vertical extent in Missouri is 600 feet, it averages about 300 and lies chiefly in the lower coal measures, although extending nearly to the top of the middle measures. It is also found in the Lower Carboniferous limestones.

The bituminous sandstones very nearly resemble those exhibited at the Centennial from Werwohlen, Brunswick, Germany. An analysis of free bitumen from Oronogo, Jasper county, gave bitumen 95.75 per cent., ash (pale yellow) 4.25 per cent. Bitumen mixed with sand from Barton county, Mo., gave bitumen 44.74, ash 55.26.

In 1872 a boring was made near the Union depot, Kansas City, to a depth over 700 feet. Bitumen was found, and it is said that it rose to the surface from 180 feet depth and also from 291 feet. The geological horizon of the bitumen was evidently in beds of the thick shaly sandstone deposites of the Middle Coal measures, and undoubtedly of the same horizon as the bituminous sandstone of the Sander's well of Ray county. This latter well was bored 802 feet in search of petroleum, and proved to be a poor investment, as also did the well of about the same depth north of Richmond.

* R. W. Raymond, in Eng. and Min. Journal, January, 1877.

The well on McCausland farm, Lafayette county, was bored about 800 feet for oil, and after much attendant expense was abandoned. Bitumen here occurs in the upper sandstone of the Lower Coal measures. We know of oil and tar springs in Cass and Johnston, but in these counties people have wisely abstained from expensive search.

On Mormon fork, in Bates county, a well has been bored about 700 feet deep, but developed but little oil, although it proved of interest to the geologist and searcher for coal in proving the existence of two thick coal beds.

South of Butler, Bates county, is found a limestone with small cavities previously occupied by fossils, now filled with bitumen, and on Mulberry creek we find a four foot bed of very bituminous limestone. A similar rock is also occasionally found on the Little Osage river and Marmaton river near Fort Scott, and has been called Fort Scott marble, but is too hard to polish ever to be of much economic use.

On Shiloh creek, Vernon county, there is a small spring of clear water, but having a strong taste of petroleum.

In the southern part of Vernon and the northern part of Barton several wells have been sunk in search of petroleum. Many of the rocks of this district are so strongly saturated as to be quite black and are often quite tough from the cementing power of the bitumen, and some of the limestone beds, where convenient for transportation, may yet prove of value as material for street paving. In Europe such rocks are preferred.

Nearly all the coal and many of the rocks of Southwest Missouri, when freshly broken, give out an odor of bitumen. Bitumen is often quite abundant in the lead mines of Jasper county, intimately associated with the mineral.

OTHER BITUMINOUS ROCKS.

Certain thinly laminated rocks, ordinarily termed shales, or slates, occur in the Utica slate of the Lower silurian system, as wells as the Marcellus and Gennessee of the Devonian rocks of Canada and New York. It is well known that similar beds are of frequent occurrence in our coal measures in every State where coal is found. Dr. T. Sterry Hunt has appropriately termed them "pyroschists," and defines them to be argillaceous rocks containing, in a state of admixture, a brownish insoluble and infusible hydrocarbonaceous matter, altered to lignite or coal. Some of these strata contain, in the absence of oil wells, sufficient oil to distil for illuminating purposes.

There are thirteen bituminous shale beds in the Illinois coal field aggregrating thirty-four feet thickness.* In Missouri our estimate is twenty-one beds, with an aggregate of thirty-nine feet. This in a thickness of nearly 2,000 feet of coal measures. A few of these blend into a cannel coal, for instance certain beds in Johnson county and the Breckenridge coal of Kentucky. From the latter there was formerly distilled a good quality of illu-

*Ill. Geol. Rep., Vol. vi.

minating oil, in fact it was quite celebrated, but the discovery of the rich flowing wells of Pennsylvania suspended its production. The following table includes analyses of some of the the Kentucky pyroschists as determined by the Second Kentucky Geological Survey:

No.	County.	Thickness in Feet.	Specific Grav.	Moisture.	Vol. Comb.	Total Vol.	Coke.	Ash.	Carbon in Coke.	Sulphur.
1	Edmondson...........	6	1.362	0	59 7		40.30	26.		
2	Menefee	22		2 80	15.2	18	82 00	57.7	24.30	
3	Wolff.....................		14.34	1.30	41.4		57.30	29.1	28.20	0 84
4	"	3	1.383	1.16	44.58		54.26	21.5	32.76	0 53
5	Breathett................	3	1.36	1.60	43.2		55.20	21.4	33.80	2.55
6	McLean..................			1.60	36.4		62 00	30.64	31 30	
7	Mulhenburgh			3.56	13.68	17.24	82 76	75.94	6.82	

Specimens of these were in the Kentucky collection at the Centennial. Most of them are from the base of the coal measures. Number 1 is a cannel shale, which burns freely, is found under a considerable area in Butler county, and is six feet thick. No. 3 is also a cannel shale, which will form a pulverulent coke. No. 4 is also a cannel shale, over three feet in thickness, from Stillwater creek. No. 6 is from Wright's, on Frozen creek. No. 7 is a carbonaceous mud.

West Virginia, Pennsylvania, Ohio, Indiana, Illinois, Missouri, Iowa and Kansas abound in similar bituminous shales.

The bituminous shales of Collingwood, Ontario, when distilled, yield three to four per cent. of tarry oil, which, when rectified, affords illuminating and lubricating oil. The available shale bed is seven feet thick, and its geological position the Utica slate. The best bituminous shales at the Albert mines yielded sixty-three gallons per ton, and 7,500 feet of gas per ton. They belong to the Carboniferous.

NEW SOUTH WALES.

The Kerosene shale beds underlie a surface of six hundred square miles. Their geological position is in the Upper Coal measures. A section at Hartley Vale Kerosene Coal Company's mine, eight miles east of Bowenfels, gives:

1. (at top) 1 foot 6 inches fire clay.
2. One inch clay brand.
3. Three inches black casing.
4. Four inches impure shale yields forty gallons of crude oil.
5. Six to eight inches black shale.
6. One-half to eight inches band of inferior fuller's earth.
7. Eight inches ferruginous shale.
8. One-half to eight inches wet pipe-clay.
9. Three feet two inches kerosene shale, yielding up to eighty gallons refined oil per ton.
10. Ten inches "bottoms," yielding sixty gallons of crude oil per ton.

11. One-half to one inch yellow band of fuller's earth.
12. Bluish sandstone, with impressions of plants.

The *Glossopteris Browniana* is found in the above bed of kerosene shale.*

The kerosene shale occurs in even laminæ, is quite hard and breaks with a regular conchoidal to splintery fracture, with a shining surface. It is really a rich cannel shale. The Murrurundi Petroleum Oil Cannel Company work this shale, one hundred and thirty miles northwest from New Castle. At this place it is fourteen inches thick, resting on nearly eight feet of coal and clay. The proprietors are R. Towns & Co., of Sidney, who had an exhibition at the Centennial. The New South Wales Shale and Oil Company, of Sidney, had on exhibition a block showing the entire thickness. They undoubtedly possess the richest seam of kerosene shale; its greatest thickness is five feet, the middle three feet—the richest. They manufacture kerosene, lubricating and other oils from the mineral. The shale from the Hartley mine is shipped by rail eighty miles to the works, near Sidney, and is also exported for gas-making. An important locality is at the foot of Mt. York. Hundreds of thousands of dollars are invested in this industry, and the oil is used for illuminating purposes and gas-making, for which purposes it is chiefly exported to San Francisco, India, China and other places, but its chief exportation is to other Australian colonies and New Zealand. There is a slight import duty, but the Kerosene Company have possession of the market and control the trade. The shale yields 18,000 cubic feet of forty candle, or one hundred and sixty gallons of crude oil per ton, from a three feet two inch seam. On page 56, of Mines and Mineral Statistics of New South Wales is the following table of production of crude oil:

YEAR.	TONS.	VALUE, £.
1865	570	2,350
1866	2,770	8,154
1867	4,079	15,249
1868	16,952	48,816
1869	7,500	18,750
1870	8,580	27,570
1871	14,700	34,050
1872	11,040	28,700
1873	17,850	50,475
1874	12,100	27,300
Total	96,141	261,414

At Wollongong extensive works have been established for the manufacture of oil, and sometime since specimens of shale from Megalong and Illawarra were sent to Prof. Silliman, who applied to them the term Wollongonite, under the impression that they came from Wollongong. Oil has been made from this, but it does not yield so much oil as the Hartly shale.

*Mines and Mineral Statistics of New South Wales—Sydney, 1875.

ALBERTITE.

This remarkable mineral very much resembles the asphalt of commerce in being black, brittle and lustrous, with a broad conchoidal fracture; but it is less friable and its composition is also different, and it differs in fusibility and its relation to various solvents. The color of its powder is porcelain black, lustre resinous and splendent or shining, perfectly opaque, very brittle, odor bituminous; when rubbed is electric, burns and emits jets of gas in the flame of a spirit lamp, but does not melt like asphalt, but can be melted in a close tube. Under the microscope it presents no appearance of organic structure, and is free from mineral charcoal or impure coal. Its composition is, volatile combustible matter 57.20, ash in coke .27. It is found in King's, Albert's and Westmoreland counties, New Brunswick, and its position is in the Lower Carboniferous Coal formation, in calcareo-bituminous shales or pyroschists, which contain much bituminous matter, also many fossil fishes of the genus *Palaeoniscus*.* These shales have been much disturbed and contorted and, quoting from Dr. Dawson: "At the pit, the beds dip at angles of 50° and 60°, and near the bottom of the shaft consist of calcareous and ironstone bands and concretions. The Albert mineral occupies a vein in these beds, having an irregular high dip, preserving a general course of north 50° east to north 65° east, and at one place is as much as seventeen feet wide, thinning to one foot. Twelve hundred feet northeast it bends suddenly northwestwardly, the course bearing north 29° east for twenty-five feet, then returning to north 50° east. The vein has been worked to a depth of 1,162 feet, and occupies a regular fissure formed by an abrupt anticlinal or arching of the shale beds, appearing to be parallel to them, but its age is not therefore contemporaneous, for there are no stigmaria underclays which might be expected in a stratified coal bed.†

The mineral must have been, at some former time, in a liquid state and subsequently hardened, for a little is occasionally found in the spaces between the wall rocks.‡ Albertite in small quantities has been found at other localities—some of them fifty miles distant.

The chief export has been to the United States for making oil, and partly for admixture with ordinary bituminous coals in the preparation of illuminating gas. It yields one hundred gallons of crude oil to the ton, or 14,500 cubic feet of superior illuminating gas. The royalty paid to the government up to January 1, 1866, was $8,089.29, and the amount exported for twelve years, from 1863 to 1874, inclusive, 154,800 tons. The yield from the mine is now becoming less, and the probability is that it will be exhausted before many years.

GRAHAMITE.

This, sometimes called Ritchie Mineral, was discovered in Ritchie county, West Virginia. It occurs under similar circumstances to albertite and

* Acadian Geology, by Dr. Dawson. † Dawson, Acadian Geology. ‡ Ibid.

very much resembles it, and is used for similar purposes. It occupies a vertical crevice of four to four and one-half feet wide, occurring in the barren coal measures, above the horizon of the Pittsburgh coal. It has been worked, vertically, for three hundred feet and, horizontally, for 3,315 feet. The direction of vein is 12° north of west. It was undoubtedly first deposited in a liquid state, subsequently hardening. An analysis by Prof. Wurtz gives specific gravity, 1.145; carbon, 76.45; hydrogen, 7.83; oxygen, 13.146; ash, 2.26.*

MEXICO.

In the eastern part of Mexico, north of Vera Cruz, bituminous rocks occur, and some coralline limestones are thoroughly saturated with it. An asphaltum also abounds, which Prof. J. P. Kimball likens to Grahamite.

PERU.

At Caxitamba is a small pitch lake, the bitumen from which is found useful in stopping leaks of boats.

ARGENTINE REPUBLIC.

Liquid Bitumen occurs in large quantities. Kerosene oil is made of it.

CUBA.

There were several fine exhibits of asphaltum from Cuba in the Spanish section at the Centennial. The bitumen yields one hundred to one hundred and forty gallons of oil to the ton, and when purified is admirably adapted for lamps. Daddow and Bannon say that the chapapote or asphalt is mined, like coal, occurring in fissures in the rocks;† and flowing springs of petroleum are said to still exist in the vicinity, emanating from fissures extending to the underlying metamorphic rocks. The rocks of the whole island seem to be impregnated with bitumen, and there are numerous petroleum springs.

ISLAND OF TRINIDAD.

The wonderful Lake of La Braye, according to Parkinson, is one and a half miles in circuit, is hot at the centre but solid and cold towards the shore. Its borders, for a breadth of three-quarters of a mile, are covered with hardened pitch, on which trees flourish. At Point La Braye, the masses of pitch look like black rocks among the foliage, or as black vitrified rocks.‡ The lake is partly surrounded by mangrove swamps, excepting towards the sea, and what is remarkable, the lake itself is on higher ground than the neighboring swamps. Its outer margin is solid asphaltum, but further inwards the bitumen, of the consistency of thin mortar, is seen flowing, but in time hardens, and this outward flowing gradually encroaches on the harbor. The outer walls can be cut with an ax, and in appearance resemble an impure cannel coal, but are more gray. On some parts of the surface are seen thin pieces of black, shining asphaltum.

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* W. D. Fontain, in American Journal of Science, December, 1873. † Iron, Coal and Oil—Daddow and Bannon. ‡ Organic Remains of a Former World.—Parkinson.

According to Gesner the surface of the lake is occupied by small ponds of clear water, in which are found several kinds of beautiful fish.* This remarkable lake is said to repose on recent Tertiary beds—Miocene and probably Pliocene. The odor of the mineral is apparent in the atmosphere, and it is asserted that it can be detected at eight miles distance. The bitumen, according to Gesner, yields by distillation a whole series of hydrocarbon oils, and gives seventy gallons of crude oil per ton of 2240 pounds. It is much valued for ship bottoms, and is reported to kill the teredo.

GERMANY.

The asphaltum of Werwohlen, Brunswick, is found in a sandstone which is said to be of Tertiary age. It very nearly resembles the bituminous sandstone of the coal measures of Southwest Missouri. It is used for roofing, for which purpose it is said to be well adapted, as it does not melt under ordinary sun exposure, and in the preparation seven-eighths inch asphalt is laid on three and one-half inches of cement.

SPAIN.

At Mastu, Vittoria, there occurs a fine-grained, black, bituminous limestone, and from it is made refined asphaltum.

SWITZERLAND.

The asphalt from Val de Travers has a world-wide reputation as a paving material. It is said not to crack in cold weather, being not affected by changes of the weather, nor does it possess a bad odor. Parkinson, in 1804, stated that on the south side of a mountain, the northern declivity of which terminates in the Valley of Travers, between Travers and Couvet, near to Neuenberg, there are two large pits containing asphaltum, which, in 1758, had been worked upwards of forty years. At the same height, on the other side, it was also found.

At Neuchatel it occurs, impregnating a limestone bed in the cretaceous formation, and serving as a cement to the rock, which is used for buildings. The rock is quite black and strongly impregnated with it. The Neuchatel limestone at this time (1876) has been worked for forty years, and is extensively used throughout Europe for paving and for roofing purposes. The principal agency is in London, but the asphaltum is used in all the chief European cities. In London it is found better to use it in a pure state. In Paris it is very much used, where it is mixed with rock. The Swiss Commissioner at the Centennial informed me that he had an acre paved with it at Neuchatel that had been in use for fifteen years without repairs. In Switzerland the preparation for roofing is generally: (1.) Flat tiles are laid in mortar on an inclined roof. (2.) Then pure asphalt is poured on to the depth of an inch. (3.) Then clean gravel is placed on the asphalt as closely as possible, causing it to present the appearance of a

* Coals, oils, etc., by Gesner.

gravel roof, or stone pavement. Asphaltum is also found in other localities in Switzerland.

OZOCERITE.

This is quite different in appearance yet closely related to the above. It is in part a native paraffin, has a general yellow or yellowish brown to dark color, and is of a waxy appearance—indeed it much resembles beeswax, especially when refined; is soft and easily pressed with the finger nail. Hoffstadster's analysis of two specimens give: A, with melting point of 61°, carbon 84.94, hydrogen 14.87; B, with melting point 65°, carbon 85.78, hydrogen 14.29.* It is soluble in ether, turpentine or naptha. The products are a wax or resin, both of a delicate white and yellow. Candles are made of it, but they do not possess a pleasant odor. It occurs in a bituminous clay, associated with calciferous beds, in the Carpatians; also in sandstone and shale of the Cretaceous formation, from forty to one hundred and sixty metres from the surface. The Ozocerite at the Centennial was from Boryslaw, in Gallicia. At this place it is associated with rock salt, asphaltum and fibrous gypsum, the latter penetrated by asphaltum. The annual production of Boryslaw amounts to 15,000,000 kilogrammes, worth eight to twenty kreutzers per kilogramme, or four and one-half to seven pence per pound. It is also found at Slanik, Moldavia, Gaming in Austria, in Transylvania, and at Uphall in Linlithgowshire, also near Lake Baikal.

COORONGITE, ELATERITE IN PART, OF DANA, ELASTIC BITUMEN—MINERAL CAOUTCHOUC.

Elaterite has been considered a carbo-hydrogen, near ozocerite, of which Dana gives carbon 84.3, hydrogen 12.5, the loss probably wholly or in part of oxygen.

Coorongite, in a condensed form, resembles crude India-rubber, occurring generally in sheets, varying in thickness from that of coarse brown paper to an inch thick, these evidently being the result of evaporation on the surface. It is found along the Coorong coast of South Australia, for over a hundred miles in length, and an average breadth of twenty miles.† Over this area it may be collected in drops, floating on the water of recently sunk wells, or in crevices of the underlying limestones, or in patches of various areas, from very small to several acres, of a leathery consistency, or else diffused through a diatomaceous earth, forming a black petroleoid matter. Bitumen is also found.

Coorongite burns freely with a reddish flame, melting like bitumen, emitting but little odor. It produces an oil, a tar, and a white wax, or paraffin, and has been made into a brilliant illuminating kerosene oil, said to be non-explosive, and not inflammable under a temperature of 150°. Considerable oil can also be made from the distillation of the soil of the district. Elastic bitumen has also been found in Derbyshire, accompanied

* Dana's Min., p. 732. † The country is mostly flat, with occasional swamps and some salt lakes.

with asphaltum; in a coal mine of Montrelais, a few leagues from Angers, France; also in a coal mine near Southbury, Mass.

Two substances, *Amber* and *Kauri Gum*, although very much differing from the above in their uses, yet are hydro-carbons. I therefore briefly notice them.

KAURI GUM.

[We possess no analysis of this, but it is nearly related, if not identical with Ambrits, of Dana.]

The *Dammara Australis*, or Dammara Pine, is a coniferous tree, common in New Zealand; also grows in the Molucca Isles and Amboyna. It is very resinous and quite valuable.

In New Zealand the gum is found in large quantities in a fossil state, occurring in the Tertiary formation (according to Dr. Hector, the Provincial Geologist), at depths from five to one hundred feet below the surface, and in amorphous masses weighing from one to three hundred and fifty pounds. Dr. Hector is confident that this gum has originated from the Dammara pine. Its color is grayish yellow, fracture conchoidal and of a glassy brightness. At ordinary temperatures it remains solid, but very warm weather causes it to become slightly flexible, and when rubbed it gives out a terebinthine odor. It is much valued for making varnish, being superior as an article for making furniture and implement varnish. It is valued according to color and purity. At Auckland the clear, cheap article bringing $90 per ton; the dark, clear and scraped $240, and the bold, bright, selected $300 to $350 per ton. The export from New Zealand, in 1874, was 2,600,000 tons; value, $440,000. It is largely exported to various countries, a great deal being brought to the United States. The gum and its various products were exhibited at the Centennial.

AMBER OR SUCCINITE

is a vegetable resin, altered by fossilization, sometimes inclosing insects which retain their perfect forms and appendages. It burns with a yellow flame, emitting an agreeable odor and leaves a black, shining, carbonaceous residue. Its composition is, carbon 78.824, hydrogen 10.228, oxygen 10.9. Its hardness, 2—2.5.*

Amber is harder than most resins and is susceptible of a good polish. It is used for necklaces, mouth-pieces for cigars and for varnish. It was known to the ancients and called *Electrum*, on account of its electrical susceptibility; it was also engraved and used by the ancients for seals.

It occurs abundantly on the Prussian coast of the Baltic, from Dantzig to Memel. It is also found on the coast of Denmark and Sweden; also in Gallicia, Poland, Moravia, the Urals, Switzerland, near Basle; France, near Paris; near London; in various parts of Asia, and in the green sand of New Jersey; also in Japan. It is chiefly obtained from Prussia, and is not very abundant in other countries.

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* Dana.

THE ALKALINE AND BORACIC LAKES OF CALIFORNIA.

Immediately east of the range of the Sierra Nevada is an extensive region of alkaline lakes and hot springs, of which very large areas are almost totally barren, the only vegetation consisting of wild-sage, yucca, a few cacti, and scanty tufts of bunch-grass.

This district affords, in its many extensive craters and in its lavas, basalts, and obsidians, the most conclusive evidence of its volcanic origin, while its solfataras and boiling springs may be regarded as the last representatives of active vulcanicity. The region is one of great scientific interest, and, as it may eventually become industrially important, it has been thought that a brief description of the district, as well as of that of the borax-lakes, lying on the western side of the Sierra, might not be without general interest.

The most remarkable of the alkaline lakes of this portion of California are Mono and Owen's Lakes. The former lies in a depression occupying a portion of an elevated plateau of desert land, situated at the eastern base of the Sierra Nevada between the head-waters of Owen's and Walker's Rivers. The distance from the summit of the range to the lake-shore is about six miles, and the difference of elevation is about 6,000 feet. On all sides, excepting toward the Sierra, this lake is surrounded by a wide belt of desert, the total area of which is from 400 to 500 square miles.

Mono Lake is about fourteen miles long, from east to west, and nine wide, from north to south; but it was formerly much larger than it is at present; this is indicated by numerous terraces, by means of which the line of its ancient shores may be readily traced.

The water of this lake, which has a high specific gravity, and is alkaline and extensively saline, is not easily thrown into waves, but is generally smooth and glassy. Near its north shore there are springs which have produced extensive deposits of tufa, some of which rise several feet above the surface in forms resembling gigantic fungi.

There are numerous islands in this lake, two of which are of considerable size, the largest being two and a half miles long, from north to south, and the other about half a mile in length, from east to west. These, as well as a group of smaller islets lying to the north, are entirely composed of volcanic materials.

On the northeastern corner of the larger island are extensive hot springs and steam-jets, covering an area of some thirty acres, and extending into the lake. The escape of steam and hot gases from so many hundreds of vents is attended with much noise, and the sides of the orifices of many of the fumaroles are incrusted with a reddish-brown substance, which is probably chloride of iron. In the neighborhood of these springs there is a slight smell of sulphurous acid, but no free sulphur is deposited. Some of them furnish a copious supply of boiling water, large quantities of which enter the lake, and so perceptibly raise its temperature for a considérable distance around. Much gas and steam escape from a fissure caused by the sinking of a portion of the crust, while on the eastern part of the island are two well-defined craters, now filled with water.

Mono Lake is, during the summer, the resort of myriads of gulls and other aquatic birds, which are most numerous during breeding-season, but the water is believed to be entirely destitute of life, with the exception of a small crustacean, *Artemia fertilis*, nearly related to the so-called brine-shrimp (*Artemia salina*) found in the strong brine of the salt-pans on European coasts, and the *Koo-cha-bee* of the Indians, a whitish larva, occurring in immense quantities, and which is much esteemed by them as an article of food.

Stretching south of the lake is a chain of extinct volcanoes, presenting the form of truncated cones, of which the generally steep sides are covered with ashes and other loose materials. Obsidian and pumice are abundant on the surface of these cones, and also cover the plains at their base.

Owen's Valley is a narrow basin lying south of Mono Lake, and running nearly north and south for a distance of about 140 miles. Its average width may be taken at ten miles. It is bounded along its western edge by the Sierra Nevada, which in this portion of its course presents an almost unbroken wall, of which the highest peak, opposite Owen's Lake, reaches an elevation of 15,000 feet. No pass crosses it at a less height than 11,000 feet, and near the lake shore the descent from the summit to the valley beneath must have an average inclination of at least 1,000 feet per mile, the distance being from ten to eleven miles, and the difference of level between the highest point of the pass and the valley being from 10,500 to 11,000 feet.

On the eastern side of this valley are the Inyo Mountains, toward its southern end, and the White Mountains further north. This range is dry and desert-like, and not a single stream of any size flows from it into Owen's Valley, which is exclusively watered by the melting of the snows accumulated during the winter months on the eastern slope of the Sierra. Owen's river rises a short distance from the source of the San Joaquin, and, after flowing for a distance of 120 miles, falls into Owen's Lake at latitude 36° 20′ north, longitude 118° west from Greenwich. This lake, of which the water is exceedingly saline and strongly alkaline, is twenty miles long and eight wide. It has no visible outlet, and its shores are often thickly coated with a snow-like alkaline incrustation.

No fish inhabits its water, but *Koo-cha-bee* is abundant, and at certain seasons is carried in by the waves and deposited on the shores in layers of several inches in thickness. This was formerly collected in large quantities by the Indians, and, after being dried in the sun, rubbed between the hands and roughly winnowed, was crushed in a stone mortar, and made into a sort of bread, which furnished an important article of food. This insect, which has been described as a white grub, is also found abundantly in the waters of Great Salt Lake, Utah, and those of other saline and alkaline lakes of the West, and appear to be the larva of a two-winged fly which is described by the late Prof. Torrey under the name of *Ephydra Californica*, and by A. S. Packard as *Ephydra gracilis*.*

A specimen of water taken from Owen's Lake in January, 1866, had a specific gravity of 1.076, and contained 7128.24 grains of solid matter per gallon. The composition of this residue was found, calculated on an imperial gallon, to be as follows:

Chloride of sodium	2942.05
Sulphate of sodium	956.80
Carbonate of sodium	2914.43
Sulphate of potassium	122.94
Phosphate of potassium	35.74
Silicate of potassium	139.34
Organic matter	16.94
	7128.24

In adition to the substances above enumerated, iodine was present, but only in such minute proportions that its amount could not be estimated. It is also to be observed that since, for convenience of carriage, the sample of this water operated on was reduced by evaporation to one-fourth of its original bulk before being brought to this country for analysis, it is probable that some alkaline sesquicarbonates may have been originally present.

The incrustations which at certain periods of the year accumulate to the extent of many hundreds of tons on the shores of this lake mainly consist of carbonates of sodium, in which the proportion of sesquicarbonate is somewhat variable; in some specimens examined monocarbonates were alone present. Besides carbonates of sodium, these deposits contain three per cent. of chloride of sodium, and about five per cent. of sulphate of sodium, together with traces of silica.

It was proposed some years since to erect works on the eastern shore of Owen's Lake, for the purpose of refining this deposit, for the manufacture of merchantable carbonate of sodium; but whether this idea was ever carried out, I am not aware. The only serious obstacles to the success of such an enterprise would appear to arise from scarcity of fuel, and the great distance of the lake from a shipping-port.

As this lake continuously receives the waters of a considerable and constantly-flowing river, while it has no apparent outlet, it follows that it must act the part of a huge evaporating basin, in which the salts introduced by the not apparently saline water of Owen's River become concentrated to an alkaline brine. The rocks on either side of the valley through which the river flows are, to a very large extent, composed of granites, lavas, and basalts, from the decomposition of the feldspars in which the alkaline salts of the lake have doubtless been derived. The very small proportion of potassium salts present in these waters is remarkable, for although, from the cir-

* See Hayden, "Geological Survey of Montana, Idaho, Wyoming, and Utah, 1872, p. 744.

cumstances of the feldspars of the district being to a large extent triclinic, sodium might be expected largely to predominate, still so great a disproportion in the respective amounts of the two alkalies could scarcely have been anticipated. The circumstance may perhaps, to some extent, be accounted for by supposing the potassium salts to have been largely assimilated by plants during the percolation of the waters containing them through vegetable soil, while the salts of sodium, not having thus been arrested, have passed into the river, and thence into the lake.

Owen's, like Mono Lake, was at one time much more extensive than it is at present; this is evident from the occurrence of a series of parallel terraces, plainly traceable on each side of the valley. In addition to these lakes, numerous alkaline lagunes and boiling springs are met with throughout this region.

The *Artemia fertilis*, before referred to as being plentiful in Mono Lake, is also exceedingly abundant in Owen's Lake. A peculiarity of this crustacean is, that it congregates into masses which have often a strange appearance in the water. These masses sometimes stretch out in such a way as to have the form of a serpent, while at others they represent circles or various irregular figures. A gentle breeze scarcely affects water filled by *Artemiæ*, so that while on all sides the water is slightly ruffled, that which is occupied by these dense aggregations remains perfectly smooth, thus indicating the figure of the mass. On placing some of these crustaceans in a bottle filled with water, for the purpose of preserving them for subsequent microscopical examination, it was found that those which died rapidly disappeared, and on closely examining what had taken place, it soon became evident that as soon as vitality had ceased chemical action was set up, and the animal gradually disolved in the strongly alkaline brine.

Burton Springs are situated at the extreme northern point of Owen's Valley. These springs rise from the earth over an area of about eighty square feet, which forms a basin or pond that pours its heated waters into a narrow creek. In this basin a vegetable growth is developed at a temperature of about 160° Fahr., and is continued into the creek to a distance of about a hundred yards from the springs; where, at a temperature of about 120° Fahr., the algæ grow to a length of over two feet, looking like bunches of waving hair of a beautiful green color. Below the temperature of 100° Fahr., these plants cease to grow, and give way to a slimy fungus, which is also green in color, but finally disappears as the temperature of the water decreases. Dr. J. H. Wood, Jr., who has carefully examined this growth, makes the following observations with regard to it: "This plant certainly belongs to the *Nostochaceæ*, and seems a sort of connecting link between the genera *Hormosiphon* of Kützing and *Nostoc*.

"The best algologists now refuse to recognize the former group as generically distinct, and the characters presented by this plant seem to corroborate this view.

"The species appears to be an undescribed one, and I would propose for it the specific name *Caladarium*, which is suggested by its place of growth."*

Twenty miles south from Owen's Lake across a sage-brush and grease-wood waste, the surface of which is plentifully strewed with fragments of lava, pumice, and basalt, is Little Lake. This sheet of water, which is of comparatively small extent, is surrounded by huge masses of contorted vesicular lava, and evidently occupies the cavity of an ancient volcanic vent. The waters of this lake are considerably less alkaline than those of Owen's Lake, but bubbles of carbonic acid make their way to its surface in almost uninterrupted streams.

Fifteen miles east from this point are numerous hot springs; the path for the greater portion of this distance lies over lava-flows, which render traveling slow and fatiguing. At the principal group of springs the ground is covered, over a large extent, by innumerable cones of plastic mud, vary-in height from a few inches to several feet; these rise above the surface of a seething swamp, and give issue to steam and jets of boiling water. In some cases the steam and gases, instead of issuing from cones as above described, are evolved under the surface of water and mud contained in basin-shaped reservoirs formed in the decomposed rock. By these means are produced multitudes of boiling caldrons in which violent ebullition keeps clay in a constant state of suspension; this clay varies in color from bluish gray to bright red. The waters of these springs are much employed by the Indians as an embrocation for the cure of diseases of the eye; on examination they were found to contain forty-eight grains of solid matter to the gallon, of which amount twenty-six grains are sulphate of aluminium; in addition they contain lime, soda, potash, and a little free sulphuric acid.

Borates of sodium and calcium occur in various localities in North America. The two borax-lakes are both situated near the shores of Clear Lake in Lake County, California, seventy miles northwest of the port of Suscol, and one hundred and ten from the city of San Francisco.

The larger of these lakes is separated from Clear Lake by a low ridge of volcanic materials loosely packed together, and consisting of scoriæ, obsidian and pumice; it has an average area of about three hundred acres. Its extent, however, varies considerably at different periods of the year, as its waters cover a larger area in spring than during the autumnal months. No stream flows into its basin, which derives its supply of water partly from drainage from the surrounding hills, and partly from subterranean springs discharging themselves into the bottom of the lake. In ordinary seasons its depth thus varies from five feet in the month of April to two feet at the end of October.

The borax occurs in the form of crystals of various dimensions, imbedded in the mud of the bottom, which is found to be most productive to a depth of about three and a half feet, although a bore-hole which was sunk near

† Silliman's Journal, vol. xlvi, 1868, p. 33.

its centre to the depth of sixty feet afforded a certain amount of the salt throughout its whole extent.

The crystals thus occurring are most abundant near the centre of the lake, and extend over an area equivalent to one-third of its surface; they are, however, also met with in smaller quantities in the muddy deposit of other portions of the basin. The largest crystals, some of which are considerably above a pound in weight, are generally inclosed in a stiff blue clay, at a depth of between three and four feet; and a short distance above them is a nearly pure stratum, from two to three inches in thickness, of smaller ones; in addition to which crystals of various sizes are disseminated through the blue clayey deposits of which the bottom consists.

Besides the borax thus existing in a crystallized form, the mud itself is highly charged with that salt, and, according to an analysis by Dr. Oxland, affords, when dried, in those portions of the lake which have been worked (including the inclosed crystals), 17.73 per cent. Another analysis of an average sample, by Mr. G. E. Moore, of San Francisco, yielded 18.86 per cent. of crystallized borax. In addition to this the deposit at the bottom of the other portions of the basin, although less productive, still contains a large amount of borax.

Water collected from Borax Lake, in September, 1863, was found by Mr. Moore to contain 2401.56 grains of solid matter to the gallon, of which about one-half was common salt, one-quarter carbonate of sodium, and the remainder chiefly anhydrous borax, equal to 535.08 grains of crystallized salt to the gallon. Traces of iodine and bromine were also detected. A sample of water taken from the interior of a coffer-dam sunk in the middle of the lake, and which has been allowed to fill by percolation from the bottom upward, was found to be more concentrated, yielding 3573.46 grains of solid matter to the gallon, but it contained the same ingredients, and in nearly the same proportions as the water from the lake itself. When evaporated to dryness, this water yields a considerable quantity of finely-divided carbon, resulting from the various organic bodies which have been dissolved in it.

Mud from the bottom of Borax Lake is in high repute among the local Indians as an *insecticide*, and is used in the following way: The head of the patient is thickly plastered with mud, which is well rubbed in, and then allowed to become perfectly dry; when dry it is removed by rubbing between the hands, and with it disappears the colony of parasites. Ordinary clay is, under pressure of circumstances, sometimes employed for this process of shampooing, but when alkaline or boracic mud is available, it is considered more efficacious.

When this locality was visited by me in 1866, borax was manufactured exclusively from the native crystals of crude salt, while the mud in which they were found was returned to the lake after a mechanical separation of the crystals by washing. The extraction of boracic mud was affected by the aid of sheet-iron coffer-dams. The only apparatus employed consisted of a raft, covered by a shingled roof, provided with an aperture in its centre about fifteen feet square, above which were hung, by suitable tackle, four coffer-dams, each six feet square in horizontal section, and nine feet in depth. This raft, or barge, was successively moored in parallel lines across the surface of the lake, and at each station the four dams were sunk simultaneously by their own weight into the mud forming the bottom.

When they had thus become well imbedded, the water was baled out, and the mud and crystals removed, by means of buckets, into rectangular washing-vats, into which a continuous stream of water was introduced from the lake by Chinese pumps, the contents being at the same time constantly agitated by the aid of wooden rakes. In this way the muddy water continually flowed off, finally leaving a certain amount of crude borax at the bottom of each tank; this was purified by recrystallization. From the density acquired by the 70,000 gallons of water daily employed for this purpose, it is evident that only about one-half of the borax existing in the form of crystals was thus obtained, while the mud was again returned to the lake.

Instead of the coffer-dams, a small hand-dredging machine, worked, like the former, by Chinese labor, was subsequently introduced; but the mud brought up by it was subjected to the wasteful process of washing before described.

The crystals of crude borax thus daily obtained amounted to about 3,000 pounds; these were dissolved in boiling water, and recrystallized in large lead-lined vessels, from which the purified salt was removed to be packed into boxes, each containing 114 pounds, in which it was forwarded to San Francisco. The loss of weight experienced in the process of purification amounted to about thirteen per cent.

Shortly after my visit in 1866, the manufacture of refined borax at Big Borax Lake was suspended, and I am not aware whether it has been resumed, but the works do not appear to have been in operation in 1874.

Little Borax Lake covers an area of about thirty acres, and is usually dry during the months of September and October; it is then covered by a white crust, which is collected by Chinese laborers and carried to the works, where it is refined by recrystallization. *Ulexite*, a double borate of sodium and calcium, is brought to this place from Wadsworth, in the State of Nevada—a great distance, with several trans-shipments—to be treated at these works; it appears that on account of the presence of carbonate of sodium, and the cheapness of fuel, this can be done more cheaply here than in Nevada.

Clear Lake is a large and picturesque sheet of water, twenty-five miles long, by about seven wide, surrounded by mountains, which in many places rise abruptly from the water's edge. Boat-life on this lake is delightful; the water is smooth, there is usually a sufficient breeze for sailing, and should it fall calm, an Indian can always be hired to row.

Lying about a mile beyond the ridge which borders Borax Lake on the northeast, and at the foot of a shorter arm of Clear Lake, which extends off to the southward parallel with the larger one, is an interesting locality, known as the "Sulphur Bank." It is some six or seven acres in extent, and consists of a much-decomposed volcanic rock traversed by innumerable fissures, which has become almost covered by a large accumulation of sulphur.

From the fissures steam and gas are constantly issuing, and over and through the mass large quantities of sulphur have been deposited in such a way that at a short distance the whole bank appears to consist of this substance. Into some of these cavities a pole may be inserted for a distance of several feet, and they are often lined with stalactites and beautiful crystallizations of sulphur.

Sulphur is being constantly deposited, and its deposition is attended by the evolution of carbonic and boric acids. The gaseous matters issuing from these crevices appear to be the agency by which the various substances now deposited in the cavities have been brought to the surface. Sulphur is deposited on the sides of the various fissures either in the form of crystals or as amorphous, translucent masses of a beautiful yellow color. It is sometimes intermixed with cinnabar, the presence of which was first discovered by Dr. Oxland; but more frequently with minute cubical crystals of iron pyrites. Pulverulent silica, blackened by some hydrocarbon resembling coal-tar, is also frequently observed.

On the sides of the cavities colloid silica is found coating chalcedony and opalescent quartz in the various stages of formation, from the gelatinous state to that of the hardest opal. The indurated material is sometimes colorless, but is more frequently permeated by cinnabar and iron pyrites, or blackened by the tarry matter before referred to. Cinnabar is also found in laminæ, and occasionally even in veins and concretionary masses of considerable thickness.

In addition to being employed as a source of sulphur, this deposit has been worked for quicksilver, and has produced large quantities of that valuable metal.

On the shore of Clear Lake, near the sulphur bank, is a hot spring, of which the outlets, even when the water is low, are partially beneath the lake, so that the amount flowing from it cannot be ascertained. Hot water, however, rises through the sand at various points extending over a considerable area. A specimen of water collected by Mr. Moore from this spring was found by him to contain 184.62 grains of common salt, 76.96 grains of bicarbonate of sodium, 36.37 grains of free carbonic anhydride, 103.29 grains of borax, and 107.76 grains of bicarbonate of ammonium, in an imperial gallon; besides silica, alumina, and traces of various other substances.

Prof. Whitney remarks with regard to this spring: "The most extraordinary feature in the above analysis is the very large amount of ammoniacal salts shown to be present in this water, in this respect exceeding any natural spring water which has ever been analyzed. Mr. Moore thinks that, as in the case of the boracic-acid waters of Tuscany, ammoniacal salt may be separated and made available for economical purposes. This locality is worthy of a most careful examination, to ascertain how considerable a flow of water can be depended on."*

Dr. A. Blatchly, of San Francisco, in speaking of the geyser group of quicksilver-mines, says: "Nearly all these veins contain iron in considerable amounts, frequently in sufficient quantities to constitute an ore of iron. Gold, silver, and copper, are also frequently constituents of these lodes, and occasionally chrome-iron in considerable quantities. But, so far as is known, in no instance have the precious metals been sufficiently abundant to pay for the expense of extraction.

"Bitumen is found in nearly all these veins, sometimes a deposit of a gallon or two in one cavity.

"Thermal springs are numerous throughout the whole quicksilver-region, and the uniformity of their occurrence leads prospectors to the belief that there is an intimate relation between the causes which generate thermal springs and produce deposits of cinnabar, and that where one is found the other may probably occur in the vicinity."†

On the eastern slope of the Sierra Nevada, near Walker's Pass, borax is found in what appears to be the bed of an ancient lake, large crystals of this substance having been met with in a hardened mud, exactly resembling those found in the blue clay of Borax Lake. By far the largest amount of borax is, however, obtained from the indurated mud, where it exists in common with other salts. This mud, from which borax is separated by lixiviation, contains about half its weight of that salt, and is a light, clay-like body, having a strongly saline and alkaline taste. The portion insoluble in water effervesces on being attacked by hydrochloric acid, and contains silica, alumina, lime, ferrous oxide, and magnesia. Similar deposits containing borax exist in Panamit and Death's Valley, in Lower Nevada; but these desolate districts have not as yet received so careful an examination as they deserve.

About twenty miles west of San Bernardino is the so-called "Cane Spring District," where ulexite or boronatrocalcite is found, over an area about ten miles in width by fifteen in length. The surface of the ground is covered by eflorescent salts, commonly known as "alkali," beneath which the borax salts (chiefly ulexite) are found at a depth of only a few inches.

At Hot Springs, in the northwestern portion of the State of Nevada, at a height of 4,500 feet above the level of the sea, and where the water issuing from the ground has a temperature of about 190° Fahr., there are deposits of boronatrocalcite, extending over considerable areas. Here, as far as the eye can reach, nothing is seen but barren mountains, formed of a black, porous lava; while the valleys are covered by an efflorescence of a mixture of common salt and sulphate and carbonate of sodium. In other cases the sands of these mountain-valleys contain deposits of more or less pure boronatrocalcite.

* "Geological Survey of California," p. 100. † "Mineral Resources west of the Rocky Mountains," 1875, p. 176.—Raymond.

Geysers and hot springs are numerous in the whole of this district, and from the number of extinct geyser-vents still visible they were probably, at one time much more numerous than at present.

The analysis of an average sample of the boracic material from Nevada afforded Mr. Loew the following results:

Boronatrocalcite	22.13
Chloride of sodium	2.80
Sulphate of sodium	2.62
Sulphate of calcium	6.17
Carbonate of calcium	3.01
Carbonate of Magnesium	.79
Clay	19 70
Quartzose sand	26.03
Water	15.04
Traces of potash, iodine, and loss	1.71
	100.00*

The purification of crude borax (*tincal*) is effected by a simple recrystallization, but the preparation of marketable borax from boronatrocalcite is attended with considerable difficulty, more particularly as the appliances available in the remote deserts in which it occurs are of the most primitive and limited description.

When boronatrocalcite is moderately pure it is first ground and subsequently dissolved in water, with the addition of an amount of carbonate of sodium sufficient to effect the decomposition of the calcic carbonate present.

The solution is subsequently heated, and the carbonate of calcium allowed to subside, when the liquor is drawn off, and, after concentration, borax is obtained by crystallization.

Unfortunately, this mineral often contains notable quantities of gypsum, which transforms an equivalent amount of carbonate of sodium into Glauber salt, a relatively valueless product. This salt is also frequently present in the material operated upon, and thus materially adds to the difficulty of treatment. In order to avoid these difficulties, it has been proposed to treat native boronatrocalcite with sufficient sulphuric acid to transform the whole of the carbonate of calcium into gypsum, and to liberate boric acid to be subsequently saturated by carbonate of sodium. Boronatrocalcite has also been treated with excess of hydrochloric acid, in order to obtain crystallized boric acid, but neither of these processes has hitherto afforded satisfactory commercial results.

The comparatively recent discovery of large quantities of this substance in Nevada will, no doubt, eventually, to some extent, affect the Tuscan producers of boric acid; but the fact that crude boronatrocalcite varies considerably in its composition, and that it is found in situations in which its local treatment would be almost impossible, has hitherto prevented this

* *Moniteur Scientifique,* 1876, p. 1,230.

mineral from being extensively employed as a source of commercial borax. —J. Arthur Phillips, F. G. S., *in Popular Science Review.*

ASTRONOMY.

THE ASTEROIDS.

Every now and then the papers announce the discovery of a new planet. The occurrence indeed has become so frequent of late as to attract very little notice except from professed astronomers, and they, to speak the truth, are none too cordial in their welcome of the little strangers thus added from time to time to the already embarrassingly large family under their charge. For while these new planets are quite as troublesome to provide with ephemerides and orbits as their larger sisters, they are extremely insignificant as regards their importance in the economy of the solar system, being seldom more than forty or fifty miles in diameter and, as individuals, entirely without sensible influence upon the motions of other heavenly bodies. We say as individuals, because they belong to a numerous group known as the Asteroids (so called because they look like little stars), and the united attraction of the whole family does produce upon the orbit of Mars a perfectly sensible, though very minute effect, from which Leverrier has computed that the combined mass of the whole flock would suffice to make up a globe not exceeding one-third the size of the earth, and probably a good deal smaller.

At present the number of these bodies known is 172: the whole number existing is probably to be reckoned by thousands, since it would take more than five hundred of the largest of them to make up the mass named.

Ceres, the first of them, was discovered on the first day of the nineteenth century, that is, January 1, 1801.

It had been noticed nearly two hundred years before, by Kepler, that the progression in the numbers representing the distances of the planets from the sun is such as to suggest the existence of an invisible body in the space between Mars and Jupiter, and he at one time went so far as to predict its discovery. He abandoned the idea, however, supposing that in his celebrated but fantastic theory of the polyedrons he had found the key to the mysteries of the planetary system. Titius, in 1772, revived the original suggestion, and gave to the law of distances nearly the same form as that in which it was stated a few years later by Bode.

In 1781 Uranus was discovered at a distance from the sun so closely corresponding with the law as to satisfy astronomers that it could be no mere accidental coincidence, and to confirm them in the belief that there must be a missing planet outside of Mars. The impression was so strong that an organization of twenty-four astronomers was formed by the exertions of Baron Zach, to search for it. Curiously enough, however, the good fortune of discovery did not fall to any one of their number, but to Piazzi, the Sicilian astronomer, who on the opening night of the century, in the course of observations for his famous star-catalogue, came upon a star of the seventh magnitude in a place where a short time before he was sure no such object existed. In a single day its motion was sufficient to prove its planetary character, and he continued to observe it, though much hindered by ill health and unfavorable weather, until it was lost in the rays of the sun. He was the only observer, however, for in those days communication was so slow that the planet had disappeared before the Continental astronomers could be notified of the discovery; and to find it again was hardly less difficult than at first. Gauss, then just beginning his career, came to the rescue with a new and entirely original method, by which from Piazzi's six weeks of observation he deduced the planet's orbit and computed an ephemeris by means of which Zach rediscovered it on December 31st, and Olbers independently on January 1st.

In searching for Ceres, Olbers had noted carefully the configuration of telescopic stars in that part of the sky where he expected to find her, and on reëxamining the region a few weeks later he was so fortunate on March 28th, 1802, as to discover another planet, Pallas. The existence of two of these little bodies suggested the hypothesis that they originated in the breaking up of a much larger body, of which probably numerous fragments must exist which might be found by careful search near the points where the orbits of Ceres and Pallas intersect. A search was instituted, and in 1804 Juno was discovered by Harding, and in 1807 Vesta, the only one ever visible with the naked eye, by Olbers. The hunt was kept up until 1816 but without result, as the observations did not include stars sufficiently faint.

About 1830 Hencke, postmaster of the little village of Driessen, took up the subject, and after fifteen years of patient searching was rewarded by the discovery of Astræa in December, 1845. The year 1846 was sufficiently signalized by the discovery of Neptune; but since then not a year has passed without adding to the roll of the Asteroids. In 1861 and 1876 each, 10 were discovered; in 1872, 11; in 1868, 12; and in 1875, 17.

The list of discoverers includes thirty-one different names: Fourteen of them stand credited with a single planet each, and ten with five or more apiece. Dr. Peters, of Clinton, New York, heads the list with twenty-six; Luther, of Düsseldorff, comes next with twenty; then follows Watson, of Ann Arbor, with nineteen, and Goldschmidt, of Paris, with fourteen. Fifty-two of these planets were discovered in France, fifty-four by American observers, thirty-nine by Germans, nineteen in England and its dependencies, and eleven in Italy and Sicily.

The orbits of these bodies have an average radius of not far from two hundred and fifty millions of miles, with a corresponding period of a little less than five years. But individual orbits differ widely from these figures. Thus Flora, the nearest to the sun, has a period of only 1193 days— a trifle over three years and a quarter—and a mean distance of only two hundred and two millions of miles; on the other hand Hilda, the most remote, has a period of 2868 days, or very nearly eight years, and the radius of her orbit is more than three hundred and sixty millions of miles. The orbits of the large planets are all nearly circular; many of the asteroid orbits, on the contrary, are very eccentric, resembling those of comets. Thus Æthra has an eccentricity of 0.38, which amounts to saying that her least distance from the sun is considerably less than half her greatest. The inclinations of some of their orbits are no less remarkable, that of Pallas being more than 34°, while that of Mercy is only 7°, and even that is altogether exceptional among the older planets.

As has been said before, the Asteroids are very minute, too small indeed to have their diameters determined with any certainty by direct measurement; we are limited to approximate results obtained by comparing their apparent brightness with that of planets whose size and distance from the sun are known. If we knew the reflecting power of their surface—their *albedo* as it is called—we could thus arrive at reliable conclusions; but wanting this element and being obliged to content ourselves with the mere assumption that this *albedo* does not differ much from that of the planet Mars, values inferred in this way must be accepted with a good deal of reserve. Littrow, Lespiault, and others have investigated the matter, and find that the diameters ot the larger ones range from three hundred to one hundred and fifty miles, while the smaller ones lie between fifteen and thirty. They are so small that a good walker could easily make the circuit of one of these microscopic globes in a single day, and unless their density is much greater than that of any of the other planets, the force of gravity must be several hundred times less than that on the Earth's surface. A stone thrown from a boy's sling would fly off into space, never to return. We have spoken of them as globes, but certain otherwise unexplained variations in the brightness of some of them, especially Pallas, have suggested the idea that they may be irregular pieces of rock rather than spheres.

As to their origin two theories are held; one that they are the fragments of an exploded planet, the other that the ring of nebulous matter, which in different circumstances would, according to the nebular hypothesis, have formed a single planet like the others in the system, was in this case broken up, mainly by the action of the great planet, Jupiter, just outside. If the first hypothesis be so modified from that proposed by Olbers as to introduce the idea of a number of disruptions, first of the original planet and afterwards of its fragments, it becomes perhaps as tenable as the second, and there would seem to be at present no means of deciding between them.

The discovery of these bodies has hitherto been effected simply by patient and assiduous search. The asteroid hunter provides himself with charts of portions of the sky about 2° square near the ecliptic, so choosing his "preserves" as to have some one of them in convenient position for observation at all seasons of the year. On the chart he marks down all the stars visible with his instrument. The principle labor lies in preparing the charts; these once made, any interlopers are readily detected, and if planets (and not merely variable stars) their motion will reveal their character in a very few hours. The only remaining difficulty is to be sure that the object is really a *new* planet, and not one of the old ones, for it has happened more than once that a discovery announced with something of a flourish has had to be given up as a mistake for this reason. Hitherto there has been comparatively little difficulty in the matter, because the "Berlin Astronomical Year Book" has published each year ephemerides of all the planets whose opposition occurs during the year. But the labor and expense of the calculations has become so great on account of the increasing number, and the results are of so little importance to general astronomy, that it has been decided to give them up partially, and the ephemerides for 1877 contain the places of only 50 out of the whole 125 which come to opposition this year. This will often render it necessary, when a supposed new planet is found, to go through a long and laborious computation in order to make sure that it is not one of those already known. It is to be expected, therefore, that unless this difficulty is somehow met, the number of annual discoveries will greatly diminish.

The race between the planet-hunters is frequently quite exciting. It has happened several times that the same planet has been discovered by two or more independent observers on the same evening, and both Goldschmidt and Peters have been so fortunate as to discover pairs of planets at a single sitting; the latter has done it twice.

While these planets are personally, so to speak, of trifling account, very valuable results are obtainable from the study of their motions. An excellent determination of the solar parallax has been deduced by Galle from observations on the opposition of Flora. The most reliable value of the mass of Jupiter is that derived from the perturbations he produces upon the orbits of some of them. One or two cases of great prospective interest are presented, where the orbits of two of these bodies so closely coincide as to render it quite possible that some time they may, if they do not actually collide, come to move around each other in an oval orbit like that of a double star.

Minute as they are, they are not to be despised, and it is more than probable that in some way, though as yet beyond prediction, they will repay the labor spent upon them. Very few scientific facts remain forever barren.—Prof. C. A. Young *in Boston Journal of Chemistry.*

POSITIONS OF PLANETS FOR JUNE, 1877.

OBSERVATORY OF VASSAR COLLEGE.

The computations and some of the observations in the following notes are from students in the astronomical department. The times of risings and settings of planets are approximate, but sufficiently accurate to enable the ordinary observer to find the object mentioned. M. M.

MERCURY.—Mercury rises on June 1, at 4h. 19m. A. M., and sets at 6h. 29m. P. M. On the 30th, Mercury rises at 3h. 17m. A. M., and sets at 6 P. M. The best time for seeing the planet is on the morning of the 20th, when it is furthest from the sun and rises an hour before it.

VENUS.—On June 1 Venus rises at 4h. 57m. A. M., and sets at 7h. 57m. P. M. On the 30th, Venus rises at 5h. 41m. A. M., and sets at 8h. 35m. P. M. Venus is small but bright, and after the middle of the month it can be seen for nearly an hour after sunset, following almost exactly the path of the sun.

MARS.—On June 1, Mars rises a little after midnight and sets at 10h. 25m. in the morning. On June 30th, Mars rises at 11 P. M., and sets at 9h. 38m. the next morning. Mars is in southern declination among the small stars of *Capricornus* and *Aquarius*, but is moving toward the north, coming into better position and increasing in apparent size.

JUPITER.—Jupiter is brilliant now in the southern sky, and will be in its best position about the middle of June. On the 1st, Jupiter rises at 8h. 50m. P. M., and sets at 5h. 51m. the next morning. On the 30th, Jupiter rises at 6h. 41m. P. M., and sets at 3h. 41m. A. M. the next day. Jupiter souths at midnight on the 20th, at an altitude of 25° 10′ in this latitude. The various changes of Jupiter's four moons can be seen with a small telescope, and many of the most interesting occur in June. On the 12th, Jupiter will be seen with only three moons until after 9 P. M., when the 1st moon will reappear from behind the planet. On the 19th, the 1st satellite will disappear between 8 P. M. and 9 P. M., by passing behind the planet, and between 10 P. M. and 11 P. M. the largest will disappear by coming in front of the planet. On June 26, Jupiter will be seen when it rises, with all four moons; but a little after 10 P. M. the first will disappear by the planet passing between us and the moon and hiding its light; this satellite will reappear in 2h. and 24m., and for a little over an hour the four moons are still seen. But the 3d or largest is very near the planet, and a little after 2 A. M. comes in front of and is lost in the light of Jupiter. The small stars around Jupiter are those of the constellation *Sagittarius.*

SATURN.—Saturn rises on June 1st, at 1h. 5m. A. M., and sets at 0h. 23m. P. M. On the 30th, Saturn rises at 11h. 10m. P. M., and sets at 10h. 29m. A. M. of the next day. Mars and Saturn rise at nearly the same time on the 30th, but Saturn is 5° further north.

URANUS.—On the 1st, Uranus rises at 9h. 57m. A. M., and sets at 11h.

49m. P. M. On the 30th, Uranus rises at 8h. 9m. A. M., and sets at 9h. 57m. P. M. Uranus is still among the stars of *Leo.*

SUN SPOTS.—The report is from April 17 to May 16 inclusive. In the photograph of April 17, there appears on the western limb the group of large spots mentioned in the last report; but from this date to April 21 clouds prevented observations, and during that time the group disappeared. On April 21, a pair of small spots was seen far advanced on the eastern limb. On April 22, this pair was followed by a pair of very small ones. During the passage across the disk, there was a continual change in the number and arrangement of the spots in these two groups. Before April 30, both had disappeared. In the picture of this date, a small group was seen on the eastern limb; but after May 5 it could not be found. When last seen, it was near the center of its course, but very faint. The observation of May 5 showed a small spot, followed by a very faint one. On May 4, these spots had not been seen, and were first visible on the western limb On May 8, a large spot was seen coming on. From May 8 to May 12 no observation could be made. On May 12, two large spots were seen near the center; one of these was seen before May 8, the other had burst out between May 8 and May 12. The one first seen on May 8 disappeared between May 13 and May 14 at about the center of its course; the other is still visible (May 16), and is at present preceded by a small spot not seen on May 15.—*Scientific American.*

ONE of the most remarkable appearances which has been seen on the planet Saturn since the time of Herschel, was noticed by Prof. Hall, of the United States Naval Observatory, on December 7. A spot so bright that it could be seen with small telescopes suddenly showed itself near the equator of the planet. It gradually spread out along the equator, so as finally to present the appearance of a strip extending over some 90°. The brightest part was not in the middle of the strip, but near one end, as if the shining material had spread itself out in one direction only. The discovery was at once communicated to several American astronomers, and the spot was observed at Albany, Hartford, Vassar College and elsewhere. It was watched during most of a month, when the planet approached near to the sun, and the band became so faint that no further accurate observations could be made on it. It does not appear to have been seen in Europe at all as the astronomical journals which have come to hand are entirely silent on the subject. The spot was utilized by Prof. Hall to determine the time of rotation of Saturn, which no one but Herschel had hitherto done. The result was about 10 hours 15 minutes, hardly a minute different from Herschel's estimate.

METEOROLOGY.

IMPORTANT BEARINGS OF METEOROLOGY ON AGRICULTURE AND HYGIENE.

The recent publications of the French Observatory of Montsouris (which is under the enterprising directorate of the *savant* just named) are highly instructive, as indicating some of the new directions in which meteorologists are working; and we will here invite attention more especially to two of these. The labors of Montsouris have elucidated the important bearings of meteorology at once on agriculture and on hygiene.

The proper object of agricultural meteorology is obviously to determine the influence of the various conditions of climate on vegetation. Everybody knows that heat, light and water are indispensable to a plant; but it is desirable to ascertain and define what part is played by each of these elements individually in the development of each plant, in each of its phases of vegetation, and in the formation of the various organic principles—starch, sugar, gluten, etc.—which it furnishes. On this problem the observers at Montsouris are busily at work noting the phases of vegetation, making "chemical analyses" of plants, taken periodically, so as to compare the progress of vegetation with the climatic conditions throughout the year, and analyzing the air and the rain with regard to the products they furnish to vegetation. This last point has excited no little interest lately. Nitrogen, of course, forms a large proportion of our atmosphere; but in this free state it does not appear capable of being assimilated by plants. It has to be offered to them in a state of combination, as in manures. Now the air often contains small quantities of natural manures of this character, viz., nitrogen compounds, which are supplied by the air to the ground; such are ammonia, nitrous acid and nitric acid. Whence they come seems still to be doubtful. There is some reason to believe that the ammonia of the air comes from the sea, and the traces of nitric and nitrous acid are said by M. Thenard to arise from electric discharges which traverse the air either in a silent and continuous manner, or in the form of sparks. Then M. Berthelot has shown that under the influence of atmospheric electricity the nitrogen of the air may be fixed directly in organic compounds of the ground, and that this fixation is favored by the development of certain microscopic plants. There is evidently here a wide field for scientific research, from which the art of agriculture may be expected to reap great benefit. The rain, too, is an instructive teacher. At Montsouris it is carefully analyzed from time to time, and (as an example of the results) it has been calculated that during the year September, 1875 to September, 1876, a total quantity of 1,363 grammes of ammonia was poured in rain on each square meter of the park of Montsouris, or more than thirteen kilogrammes per hectare. The quantity of other gaseous constituents carried down by the rain, and the irregular impurities it washes out of the atmosphere, are also recorded. The mention of impurities in the air naturally suggests the valuable services which meteorological research appears destined to render to public health. If air be drawn tor some days through a tube containing carded cotton, the cotton will be found to have turned gray, through the powdery matters it has intercepted. Now these powders are well worthy of being studied. Their nature is very varied; they contain such material matters as carbonate of lime, carbon, iron, also the debris of fires, spores of cryptogamic plants, pollen, grains of starch, etc., and excessively minute grains which are probably the germs ef living creatures. For more than a year these powders of the air have been subjected, at Montsouris, to daily microscopic analogy, and, in relation to the germ-theory of disease, which now engages so much thought, the results can hardly fail to prove of great value. It will be seen whether there is really a strict correlation between endemic or epidemic disease, and the frequency, local or general, of germs borne in the atmosphere. Perhaps it will be possible by and by to say what kind of germs produce particular kinds of disease, and to take protective measures accordingly. Indeed, not a little has been accomplished in this direction already, through the researches of Beale, Sanderson, Klein and others.

One of the means employed at Montsouris for collecting the organisms of the air consists in directing a slow current of air, produced by a small bellows, upon a drop of glycerine. In this way are especially caught the spores, pollens, particles of meteoric iron, starch grains, and debris of all kinds carried about by the wind. But the fine germs, which are of more importance, are apt to escape notice among the larger corpuscles; and, besides, in glycerine they lose the mobility which they show in water. So they are better observed in drops of water resulting from the condensation of atmospheric vapor, in night dew, in the first drops of rain, or in the dew which forms on the outside of a vessel with a freezing mixture in it; or, again, after washing the air with water from a spray-producing apparatus. Moving organisms, as has been stated, are often met with in such water, and their rotatory or irregular movements leave no doubt as to the real nature of these minute corpuscies; they are vibriones and bacteria. Sometimes, chiefly in February and March, minute colorless corpuscles, with a circular motion, are observed, which are thought to be mostly zoospores. Germs of infusoria are also frequently present. The spores of cryptogami become more abundant toward May.

Last year the municipal authorities of Paris, having decided that meteorological researches with reference to public health should be carried on in various quarters of the city, charged Montsouris to make arrangements for this purpose, and promised an annual grant of 12,000 francs. The new system, inaugurated this year, comprises at present twenty-one stations distributed over Paris. The principal object of the inquiries will obviously be the investigation of the relations between the general state of the public health and the impurities found in the atmosphere and in drinking water. The epidemic of typhoid fever which prevailed in Paris last autumn furnished the occasion for some preliminary researches of this kind, which M. Marie Davy has described to the Paris Academy. The experiments were chiefly made at the Price Eugene Barracks, which the war authorities had caused to be evacuated for disinfection. The water of an artificial dew got into the infirmary, which was inhabited several days before, was found very pure; but on scratching the floor of this infirmary, and of the rooms at different heights, a dark powder was detected, which, on being brought into water, showed a multitude of thread-like vibriones, having a slow, undulatory movement, and vibrating points which were rapidly displaced. The window sills of certain halls, particularly, gave an abundance of microscopic algæ, vibriones, bacteria, and monads. It is clear that when the troops were in the building these powders, raised by the tramping of feet and other causes, must have got mixed with the air that was breathed, and with the food and the drink. The ground of certain quarters of Paris contain them also, but in less quantities; but no trace of them is found in the subsoil, and the rooms of the Montsouris Observatory are also exempt. M. Marie attributes the epidemic in question to such living powders accumulated during summer on the ground and walls, and producing their morbid effects when the change of season rendered the conditions favorable.—*Boston Journal of Chemistry.*

A MIDSUMMER HEAT IN MAY.

For the past few days we have been experiencing a remarkable temperature for May. From a gradual and natural thermometric rise, which continued until the 9th, a sudden fall of temperature occurred, which brought back memories of winter and caused many to anticipate a rather late spring. On the 10th and 11th the thermometer at New York, where exposed in the afternoon to the air in free circulation, recorded only fifty-two degrees. At the same time of day on the 12th it rose to fifty-seven, and on the 13th to sixty-five degrees. But during these days it was noticed that a remarkable rise of temperature was taking place in the Northwest, where the pressure was low, as well as in the Southwest, where the heat of the afternoon had increased to over eighty degrees. At this time we received intelligence that a volcanic disturbance had occurred in the Pacific Ocean, causing a series of earthquake waves to break on that coast. The enormous liberation of heat resulting from this disturbance has undoubtedly much to do with the phenomenal temperature that followed. On the 14th, the isotherm of 70 degrees ran northward of the Middle and New England States and across the Lower Missouri Valley, but northward still, smaller detached areas of high temperature were moving eastward. On the afternoon of the 15th the isotherm of seventy curved into Canada and across the lake into Dakota, giving Northern Minnesota a higher temperature than New Orleans. Thus the heat erea became more clearly outlined and now covered the United States from the northern frontier to the Gulf. On the 16th the isoutherm of 70 moved southward in the Northeastern districts, but still maintained its position in the Northwest. The heat decreased in Nova Scotia, the St. Lawrence Valley and Northern New England, but increased decidedly in the Middle States, the afternoon record at New York being 79 degrees. In Missouri a considerable variation of temperature took place, and a violent tornado resulted between Fulton and Alton. The heat in Wisconsin rose to 86 degrees, when it was only 71 at Cincinnati. On the 17th still more extraordinary variations occurred in the west, far northerly points being extremely warm, while more southerly places had comparatively cool weather. The temperature at New York fell to 76 and at Boston to 53 degrees. But yesterday it rose again here to the highest yet recorded, namely, 83 degrees, and still higher at Philadelphia, Pittsburg and Baltimore, being 92 degrees at the last named city. The great heat area is, however, passing off the continent; the temperature is falling rapidly in the North and Northwest, and though we now experience a midsummer heat, we shall after a few days feel proportionately chilly when the cool wave is passing over us. During the heated term here the temperature varied only slightly on the Pacific coast.—*New York Herald.*

EARTHQUAKE WAVES.—Assistant Davidson telegraphs C. Peterson, Superintendent of the Coast Survey, in relation to the earthquake waves registered in the tide guage at Port Point, at the entrance of San Francisco harbor, May 12, to the following effect: "Sharp earthquake waves commenced Thursday, May 10, at 6:18 A. M. Five rises and falls of 9 inches in eighty minutes; then nine maxima, or crests, forty-eight minutes apart, with secondary maxima, the largest 15 inches; then six sharp rises of 14 inches each; irregular, broken crests one hour apart; then, to 5 A. M. Friday, double maxima, as at the commencement; largest rise, 8 inches, from 5:20 A. M., Friday, to 1:15 P. M., irregular maxima; then a sudden fall to 16 inches, and action continuing until 5 P. M. No well defined maximum of action by expeditions of markedly different characters. The earthquake wave of the great earthquake in Japan some years ago was 23 minutes traversing the Pacific to San Francisco."

HYGIENE.

RELATION OF VENTILATION TO DRAUGHT.

Before concluding, I am desirous of considering with you an expression which is in general use, but the frequent cause of wrong views about the change of the air. I mean the word *draught*. All kinds of complaints are habitually ascribed to it, and the danger of draughts is one of the few hygienic principles which have become thoroughly popular. Perhaps this was not all profit, because with many people ventilation and draught are synonymous; they are afraid of a draught coming from an open window, an open door, and find themselves in collision with ventilation.

There is certainly and frequently danger in being exposed to a draught—a danger which has, perhaps, been over-estimated, because men have an irresistible desire to fix a certain cause for a certain evil. All collision is avoided if the proper meanings of *ventilation* and *draught* are thoroughly understood.

Ventilation is the necessary change of the air in a closed space, at which the velocity of the air is still taken for a complete stillness, and its motion takes place all around our body. It must not be more than a little above nineteen inches per second.

Draught is a one-sided cooling of the body, or some part of it, frequently caused by a corresponding motion of cold air, but also in other ways, as by increased one-sided radiation. The danger is, in the first instance, the local perturbation in our heat-economy, which has partly local consequences, but also and chiefly disorders the nerves, acting on the calibre of our blood-vessels, our vaso-motor nerves, which have to regulate the outflow of our heat. When we are in the open, and the air is in more motion than the air of a draught, we speak of wind, etc., but seldom of draught, because the whole air-current flows equally all round us, just as in a well-ventilated room, only with greater velocity.

The vaso-motor nerves, regulating the circulation in our skin, are beyond our control, and we cannot bid them to defend us simply at the place attacked by the draught. They know only how to serve our heat-economy when the outflow of heat from our bodies is equal, or nearly so, on all sides. They misunderstand the local irritation for one spread over the whole surface, and act at once on this error. If one perspires and goes to the window with bared neck or chest, one feels a shiver not only there but all over the body, and the perspiration becomes suppressed accordingly. The blood which at the time filled the blood-vessels of the glowing skin is displaced by the contraction of its channels; but by the misunderstanding of the vaso-motor nerves it is driven not only from the exposed parts but from the whole surface toward the internal parts. If one or some of them are in some state of weakness, danger or bad consequences cannot fail. It is the same thing as with a large quantity of cold water taken in too quickly when the body is heated. A draught, then, is injurious only in so far as it causes perturbations in our heat-economy, and as these pertubations can be caused in different ways we often accuse the draught wrongly.

We hear often, "I don't like sitting near this window, close to this wall," and so on; "there is always a slight draught coming from there." We fancy that we feel the draught, the motion of a wind, but it is mostly increase of one-sided heat-loss by radiation toward the cold place. People generally believe, rather, that the wind comes through the wall. But the velocity of such a wind is too small to be felt as air in *motion*, and a piece of carpet fixed to the suspected wall does away with the supposed draught. It could, therefore, not be caused by the air-rush through the wall, because the carpet is many times more permeable to air than the wall.

I hope, in future, ventilation and draught will be to your mind two distinct things.—PETTENKOFER, *in Popular Science Monthly.*

WHY NOT HAVE GOOD TEETH?

BY A. HOMER TREGO, D. D. S.

There is scarcely a subject of a personal character so sadly neglected and so little understood, by the people in general, as the care of the teeth.

In view of this fact, in 1869 the Odontographic Society of Philadelphia (about 100 members of eminent ability) offered a prize for the best essay on the subject; the same to be published for the benefit of the public.

The prize was awarded for the following:

RULES FOR PRESERVING THE TEETH.

1st. *Cleanse* your teeth once, or oftener, every day! *Always* cleanse them before retiring at night! *Always* pick the teeth and rinse the mouth after eating!

2nd. *Cleansing the teeth* consists in thoroughly removing every particle of foreign substance from around the teeth and gums.

3rd. *To Cleanse*, use well made brushes, soft quill or wood toothpicks, an *antacid, styptic toothwash and precipitated chalk.* If these means fail apply to a reliable dentist.

4th. *Always* roll the brush up and down lengthwise of the teeth, by which means you avoid injuring the gums and necks of the teeth, and more thoroughly cleanse between them.

5th. *Never* use a dentifrice containing acid, alkali, charcoal, soap, salt, or any gritty or powerful detersive substance.

6th. *Powders* and *pastes* generally are objectionable. They injure the gums and soft parts of the teeth, and greatly assist in forming tartar. *A* *wash,* properly medicated and carefully prepared, is pleasanter and more beneficial. It dissolves the injurious secretions and deposits, and the whole is readily removed with the brush and water.

7th. *Avoid eating hot food!* Thoroughly masticate and insalivate the food before swallowing it. Frequent indulgence in sweetmeats, etc., between regular meals disturbs the process of digestion, and a viscid secretion is deposited in the mouth (from the stomach), which is very injurious to the teeth.

8th. *Parents!* Carefully attend to your children's second dentition. Gently prevail upon them, at an early age, to visit at frequent intervals, a careful and skillful operator.

Remember that four of the permanent double teeth come in at about the age of six years. They are very liable to decay early, are very large, and should never be allowed to require extracting.

Children do not "shed" their teeth as they did in former ages. Instead of being trained to masticate nutritious food, they are tempted with and allowed to "gulp down" delicacies, hot cakes, hot beverages, etc., Thus, by depriving the teeth of their natural function and overtasking the stomach, a morbid condition of the general system is produced; the "first teeth" are prematurely decayed, and the permanent set are not matured at the proper period of dentition. The consequences are terrible.

9th. *Never allow any one to extract a tooth,* or to dissuade you from having them filled, unless absolutely necessary. Many so-called dentists, actuated by selfish motives, advise extracting and sacrifice many teeth which competent operators can render serviceable for many years.

10th. *Carelessness and procrastination* are responsible for a large majority of teeth that are lost.

MARSH-FEVERS.—A substantial addition to our knowledge of the true nature of paludic fevers appears to have been made by Messrs. Lanzi and Terrigi, of Rome. Lanzi has found in the cells of microscopic algæ from the Roman marshes certain dark-green granules, which are most numerous when the plants are farthest gone in decomposition. At length these granules fill the cells, are black under the microscope, and the algæ emit an offensive odor. In the Campagna marshes are formed in winter, which in the spring develop algæ abundantly. In summer the water disappears, and the algæ then putrefy, the ground afterward growing phanerogamous plants. Toward the fall of the year the algæ in the parts still covered with water also die, and the slime at the bottom of the marshes contains quantities of the dark granules. The latter may also arise from other plants in the state of decay, even where there are no marshes. Lanzi regards these granules as a sort of ferments. Now, the pigment-granules found in the liver and spleen of individuals suffering from malaria have quite similar properties to those ferment-granules, and they can be developed quite similarly. M.

Terrigi has specially devoted himself to the means of disinfection, which may prevent the decaying process and development of the granules; he found chloride of lime, lime, and chloral, the most efficacious. With aspirators and air-filtering apparatus he ascertained that the germs rose to a height of fifty centimetres (about twenty inches) above the marsh-bottom, where they could easily be carried away by the winds. M. Terrigi found the "malaria-melanin" (as they call it) abundant in the liver and spleen of Guinea-pigs that had breathed the marsh-air for some time.—*Popular Science Monthly.*

SCIENTIFIC MISCELLANY.

CENTRAL AFRICAN HABITATIONS.

Commander Cameron, R. N, whose famous journey across Africa has proved so rich in valuable additions to our geographical knowledge of a little known portion of that continent, gives, in the record of his travels, the sketches from which the annexed illustrations are made. Both represent discoveries which will afford an excellent idea of the ethnological importance of a study of the people of Central Africa and their habits.

The explorer found in the curious village of Manyuema houses arranged in regular streets, and the latter kept scrupulously neat and clean. The inhabitants, although cannibals, are much more civilized than their neighbors, and appear to be a conquering race which enslaved the tribes of the vicinity. They are skillful iron workers, and erect furnaces which show considerable inventive ability.

It is well known that, in prehistoric times, whole villages were constructed on piles, above lakes. Relics of these villages have been abundantly found, belonging to extinct peoples representing all stages of civilization, from the age of stone down to the dawn of the iron age. It is not understood why the ancients adopted this form of habitation. Protection from hostile tribes, safety from wild beasts, and convenience in fishing, have all been suggested; but there are reasons which go to show that none of these explanations are entirely satisfactory. Commander Cameron has found the same species of dwellings in use on Lake Mohyra, in Central Africa. The inhabitants are excellent swimmers, and although provided with boats, frequently take to the water in preference to using them.

The lake dwellings are to be found in all parts of the world. The oldest known are in Switzerland, and in that country they have been thoroughly explored. They are of two kinds, those built of fascines and those built on piles. Those of fascines were commonly used on the smaller lakes of Switzerland, and wherever the bottom was too soft to hold a mass of piles firmly; those of piles were built in deeper water, where the waves would sweep away a foundation of fascines. Lake dwellings as old as the stone age are found in some parts of Russia, and in Borneo and the Malay archipelago, as well as in Africa. Herodotus mentions them on Lake Prasias, in Thrace; and as these were connected with the shore only by a single narrow bridge, the inhabitants were enabled to defy the troops of Darius. Each family occupied one hut, and caught fish by letting a basket down through a trap door.

In Switzerland, large settlements of lake dwellings have been discovered in Lakes Zurich, Constance, Geneva, Neufchatel, and others; and from one in the little lake of Moosseedorf, near Berne, a vast quantity of very interesting relics of the stone age have been found, together with weapons and implements made of teeth and horns of animals, and fragments of pottery. A lake village at Robenhausen, in the Canton of Zurich, contains numerous dwellings, and it has been estimated that 100,000 piles of oak, beech, and fir were used in its construction; and three different sets of piles indicate as many different periods of construction. Wheat, barley, burnt apples and pears, beech nuts, cherry stones, fragments of cordage, and cloth of flax and bast, and stone relics, were found here in great profusion.

Similar structures have been found also in the lakes of Scotland and Ireland.—*Scientific American.*

AMERICAN INVENTIVE PROGRESS.

The future historian of the inventive progress of this country will find that the record of the same naturally divides itself into two distinct parts, each marking a separate era. These may be termed respectively the period of conception and the period of development. During the former most of the great American inventions were first originated; during the second, which includes the present time, the tendency of inventors has been more towards seeking new applications for established principles or improving upon earlier embodiments of the same.

The first era begins with the labors of Franklin, Rittenhouse, Hare, Evans, and their contemporaries. It terminates with the end of the year 1849. Inspection of the records of the Patent Office shows quite clearly the substantial basis for the division we have suggested. The first patent granted by the United States was dated July 31, 1790, and was issued to Samuel Hopkins for a process of making pot and pearl ashes. During that year the total number of patents was but three; the following year it amounted to thirty-three, and then for sixteen years the aggregate fluctuated, falling as low as eleven and reaching as high as ninety-nine. For the seventeen years following the variations were between one hundred and three hundred, the last mentioned number not being exceeded until 1825. The increase subsequently was more rapid; and by August, 1836, when the present system of numbering the patents began (it appears with those of

Thomas Blanchard, for turning irregular forms), the total had reached 10,041; or, for the period of sixty years comprised in the first era, the aggregate amounted to 17,447. Yet in this small number are included Whitney's cotton gin, McKean's first steam saw mill, Whittemore's wool and cotton card-making machine, Hare's oxy-hydrogen blowpipe, Blanchard's tack machine, Fulton's steamboats, Hall's breech-loading fire-arms, Perkin's steel engraving, Steven's tubular boiler and screw propeller, Lowell's power loom, Burden's horseshoe and spike machinery, Mott's stoves for small coal, Saxton's magneto-electric machine, Bogardus' ring flyer for cotton spinning and the long category of other important devices of that wonderfully prolific inventor, Professor Henry's splendid electro-magnetic discoveries, Morse's telegraph, Guthrie's discovery of chloroform, Boyden's patent leather, Baldwin's improvements in the locomotive, Howe's pin machine, McCormick's reaper, Colt's revolvers, Wells' hat body machine, Goodyear's vulcanization of india rubber, Bigelow's carpet loom, Howe's sewing machine, Sickel's cut-off, Morton's discovery of the anæsthetic qualities of chloroform, Rodman's hollow casting of ordnance, House's printing telegraph, and Ericsson's steam fire engine.

To show with what rapidity inventors made improvements on inventions embodying original principles, it may be noted that in the early days of the sewing machine one hundred and sixteen patents were granted for improvements thereon in a single year; and out of the 2,910 patents issued in the year 1857, one hundred and fifty-two were for improved cotton gins and presses, one hundred and sixty-four for improvements in the steam engine, and one hundred and ninety-eight for novel devices relating to railroads and improvements in the rolling stock. In the year 1848, three years after the publication of this paper was commenced, but six hundred and sixty patents were granted; but under the stimulus of publishing those inventions as they were patented, ten years later, in 1858, the number had increased six-fold, reaching 3,710, while up to January 1st, 1850, as already stated, the aggregate of patents issued amounted to 17,447; since that time and up to the present the total is 181,015.

Curiosity here leads us to review our own work, extending back for, say, twenty years, or to 1857, a period during which 170,745 patents have been issued. We find, by actual count, that 62,662 applications have been made through the Scientific American Patent Agency for patents in the United States and abroad. This averages almost ten applications per day, Sundays excluded, over the entire period, and bears the relation of more than one quarter to the total number of patents issued in this country up to the time of writing.—*Scientific American.*

BLUE GLASS PHOTOGRAPHY.

The blue-violet glass mania abroad seems to be confined to the photographers, and the conflict over the deceptive theory is being waged, not on the question of the curative powers of the light transmitted, but regarding the assertion that increased chemical action can be obtained by glazing photographic studios with the cerulean panes. M. Scottelari, the blue glass defender abroad, has fallen into the same errors as his co-believers on this side of the Atlantic: that is, he confounds the blue-violet rays of the spectrum with blue-violet transmitted sun-light; while he also reaches the obvious absurdity that the violet ray, when isolated from the spectrum, possesses greater capabilities than it had when mingled with the other rays. It is perfectly true that the violet ray is more active, chemically, than the other rays; but the latter do not detract from it when combined with it, and the chemical action of white light containing violet rays is precisely as great as that of the violet rays separated and tested alone. Hence it follows, as a matter of course, that a window glazed with white glass transmits the whole of the solar rays which reach it, violet among the rest. A window of the same size glazed with violet glass would transmit one-seventh part of the rays reaching it, and these would be violet-colored rays; but it would not transmit one single violet ray more than the other window.

The *Photographic News* adds that, according to Draper and others, all the rays of the spectrum probably possess photogenic power on some substances; and therefore it is but just to M. Scottelari to conceive that he has found that the rays other than violet have an antagonistic influence on that ray, and obstruct its action on bromo-iodide of silver. But Mr. Thos. Gaffield, of Boston, has recently made some new investigations on this very point, wherein the inferiority of the violet glass to clear glass is most clearly shown. Mr. Gaffield's conclusion relative to the photographic aspect of blue glass accords with our own relative to its employment for curative purposes. He says: "It is undoubtedly true that violet or other colored screens may be used with advantage in cutting off too much, or in making an even diffusion of, light upon the face of the sitter; but it can never be true, while two from six leave a less number than six, that the cutting off of a third, or any fraction, of the chemical rays of sunlight by a violet glass can enable the photographer to obtain more rapid or effective results."—*American Chemist.*

A SILK-SPINNING FISH.

There is a mollusk—the *pinna* of the Mediterranean—which has the curious power of spinning a viscid silk which is made in Sicily into a textile fabric. The operation of the mollusk is rather like the work of a wire-drawer, the substance being first cast in a mould formed by a sort of slit in the tongue, and then drawn out as may be required. The mechanism is exceedingly curious. A considerable number of the bivalves possess what is called a *byssus*, that is, a bundle of more or less delicate filaments, issuing from the base of the foot, and by means of which the animal fixes itself to foreign bodies. It employs the foot to guide the filaments to the proper place and to glue them there; and it can reproduce them when cut away. The extremity of the thread is attached by means of its adhesive quality to some stone; and this done, the *pinna*, receding, draws out the thread through the perforation of the extensile member. The material when gathered is washed in soap and water, dried, straightened and carded—one pound of course filament yielding about three ounces of fine thread, which when made into a web, is of burnished golden brown color. A large manufactory for this material exists in Palermo.—*Scientific American.*

A New Use for Asbestos.—Some experiments have recently been successfully made in Italy on a new way of burning petroleum under steam boilers. The method consists simply in pouring the oil over a thin layer of asbestos. The petroleum burns with an intense heat; while the asbestos, being incombustible, is not affected, and thus not only serves as a means of retaining the oil, but, being so good a non-conducting substance, the prevention of fire from the volatile oil is obvious. In the experiments, sheets of paper placed beneath the furnace were not injured, despite the fierce incandescence of the oil above.

EDITORIAL NOTES.

KANSAS CITY ACADEMY OF SCIENCE.

At the annual meeting of the Academy of Science, held May 29th, in the rooms of the Young Men's Christian Association, the following officers were elected for the ensuing year.

President—Hon. R. T. Van Horn.

Vice President—Judge E. P. West.

Recording Secsetary—W. E. Winner.

Corresponding Secretary — Col. Theo. S. Case.

Treasurer—Dr. Geo. Halley.

Librarian—Harry H. West.

Member of Executive Committee for four years—Dr. Geo. Halley.

A resolution was passed requiring all members reading papers before the Academy to file written or printed copies with the Librarian for preservation

At the next regular meeting, on the evening of the last Tuesday in this month, a paper upon the "Remedial Properties of Heat" will be read by Prof. Geo. Halley, of this city. At the regular meeting in July an archæological article will be presented by Judge E. P. West, and for that of August, Prof. T. J. Eaton will prepare an appropriate essay, the subject of which has not yet been made known.

WESTINGHOUSE AUTOMATIC AIR BRAKE ON THE KANSAS PACIFIC R'Y.

On the 22d of May a series of tests of the Improved Westinghouse air brake was made near this city by the Kansas Pacific Railway Company, under the management of S. T. Smith, Auditor, and D. E. Cornell, General Passenger Agent. The results we give below in the report of the committee appointed for the purpose:

We, the undersigned, having been requested to act as a committee to observe, record and report the results of certain tests of the workings of the Westinghouse Improved Automatic Air Brake upon a special train fitted for the purpose on the Kansas Pacific Railway, submit the following report:

On Tuesday, May 22, 1877, a train consisting of five passenger cars, two baggage cars, with locomotive and tender, weighing in the aggregate 357,430 pounds, and carrying one hundred and thirty-five passengers, was taken to a piece of level track, about five miles west of the city, and subjected to the following test, viz.:

1st. The engineer was directed to run at the ordinary speed of twenty-five miles per hour and to apply the brake while under such headway, so as to ascertain the time required to bring the train to a full stop and the actual distance run after such application.

2d. Same as the above, except that the train was run at a speed of thirty miles an hour.

3d. Same as before, except that the train was run at the highest possible rate of speed.

4th. Test of the automatic action of the brake by causing the coupling pin between the locomotive and train to be removed while the train was in motion.

5th. Test of the value of the brake in case of fire or other accident when the bell cord fails to notify the engineer, made by applying the brake from within one of the cars while the train was in rapid motion.

6th. Test of the rapidity with which a train may be stopped and backed up to avoid a collision with another train.

DISTANCES.—A distance of one-eight of a mile was first marked off, then one of 300 feet, then seven others of 100 feet each, all plainly and prominently designated with bright colored flags and boards.

Time-keepers were selected and properly stationed, and at about 2 P. M. the tests were made in the order above mentioned with the results given below, viz.:

No. of Test.	Rate of Speed. Miles per hour.	Distance run after Application of Brake in feet and inches.	Time run after Application of Brake.
1	25 5-7	217 feet.	$10\frac{1}{2}$ sec.
2	31	298 "	11 "
3	38	$387\frac{1}{2}$ "	12 "
4	40	369 "	11 "
5	44	494 "	16 "
6	$30\frac{1}{2}$	*$395\frac{1}{2}$ "	56 "

*This distance includes the forward run as well as the backing up, and the time also covers both motions. The rate of speed in backing was ten miles per hour.

We consider the results very satisfactory and gratifying, and find, upon comparing them with those of the competitive trial on the North British Railway, in 1876, that, other things being equal, the stops were made in less time in every single instance.

THEO. S. CASE,
H. J. LATSHAW,
M. W. ST. CLAIR. } Com.

ENGINEERING IN THE ROCKY MOUNTAINS

[Correspondence.]

The Colorado Central Railroad Company, a corporation now operating a system of narrow gauge railroads in the Rocky Mountains, in connection with the ordinary 4 foot $8\frac{1}{2}$ inch gauge, have inaugurated a special system of narrow gauge railway, by which to overcome and to surmount mountain summits too steep to be overcome by ordinary grades, in the usual manner. The problem presented is, to build a narrow gauge track from Black Hawk to Central City. The distance between the present terminus, at Black Hawk, and Central is one and a half miles. The elevation at Central above the Black Hawk depot is five hundred feet, vertical, which would give for a direct line a grade of three hundred and seventy-five feet per mile, which, of course, is not possible, as the bare locomotive could not haul itself up with its tender.

To overcome this difficulty and to lengthen the line sufficiently to reduce the three hundred and seventy-five feet grade practicably, the line is laid and located along the side of tde mountain, southeast from Black Hawk, with a steady ascending grade of from one hundred and fifty-eight to one hundred and seventy-two feet per mile, terminating in a piece of level track three or four hundred feet long, upon which the train can halt. Where the ascending grade changes to a level grade a switch is placed, which moves the switch-rail to another track, which, in the same manner, ascends in a reverse course, and above the first track ascending from Black Hawk. This second ascending track winds northwest along the high mountain slope until it reaches an altitude sufficiently high to extend, with some six hundred feet of level grade, into the upper end of Central City, in Nevada Gulch, some 8,500 feet above the sea. In this part of the line, or "switchback," as it is technically called, this miniature railway crosses, in two miles length, some sixty different gold and silver mines, now being developed, and threads its devious way among a maze of shafts, pits and tunnels too numerous and too frequent for the easy prosecution of the construction party.

The view developed from these high mountain peaks will be extended, novel and of deep interest. Some twenty miles northwest we are, on a portion of this railway, faced by the high, steep face of James Peak, over 13,000 feet above the sea, while just below us we look into the chimneys, the yards and the busy streets of Black Hawk and Central City, while again to the east we see high, woody mountain ranges and a distant view of the sea-like prairies. Opposite, the mountain sides are seamed with galleries, open cuts and the broken fragments of years of active prospecting and profitable mining.

This railway is being built with great care. Its track will be wide, solidly built, and of unusually carefully selected materials, for this special purpose; rails to be fifty pounds to the yard, and it is to be provided with locomotives that can ascend with four or five cars to Central City, at the rate of eight miles per hour. All to be completed by August, 1877.

E. L. B.

EDITORIAL EXCURSION.

On the 5th and 6th of this month the Eleventh Annual Convention of the Editors of Missouri was held at Fredericktown, in the southeastern portion of the State. The usual addresses, poems and orations were delivered by the various members, and we were very hospitably and generously entertained by the citizens of the place. For the ensuing year the following officers were elected, viz.:

President, Col. J. E. Hutton, Mexico Intelligencer; Vice Presidents, Charles E. Hasbrook, of the Kansas City Price Current, and John B. Williams, of the Fulton Telegraph; Recording Secretary, M. B. Chapman, of the St. Joe Chronicle; Corresponding Secretary, W. C. Bacon, of the Boonville Advertiser; Treasurer, H. B. Cutter, of the Glenwood Criterion; Orators, G. H. Crumb, of the Poplar Bluff Citizen-Post; J. H. Turner, of the Wakanda Record. Essayists, Col. T. S. Case, of the Kansas City Review of Science and Industry; Will. J. Knott, of the Chamois Leader; J. D. Fisher, of the Troy Herald, and Adam Rodemeyer, of the Centralia Guard. For the address before the Convention, J. B. McCullagh, of the Globe-Democrat.

The Iron Mountain R. R., which connects St. Louis with Fredericktown, runs through a most romantic country, the scenery being broken into ever-changing vistas of hill and dale, mountain and river, while the beautiful orchards and vineyards and wonderfully productive mines of iron, lead and other minerals, render it exceedingly profitable to its people. Granites also, and marbles of various qualities and colors are found, while at Mine La Motte lead, copper cobalt and nickel are not only mined but smelted and separated. This property, Mine la Motte, covers an extent of 24,000 acres and 300 to 400 men find employment in the various operations carried on at the mines and works. The production of last year was 3,400 tons of lead alone. The nickel and cobalt are only reduced to a matte and shipped to Europe for refining.

After finishing the business of the convention the members accepted an invitation to visit Hot Springs, Arkansas. On the way thither we passed through the town of Charlestown, Missouri where we were shown many remarkable specimens of ancient pottery, which had been exhumed in the vicinity.

Hot Springs village is located in a very narrow valley between two spurs of the Ozark Mountains, running north and south, and consists of one street skirting along both sides of a small stream for about two miles. It is surrounded by hills on every side, and the springs, some sixty in number, start from the west side of one named Hot Springs Mountain. Their temperature ranges from 102° to 150° and their altitude above the creek bed varies from a few inches to over one hundred feet, while they are elevated above the sea level about 1,400 feet.

Their chemical constituents are not remarkable in any degree, and no one from merely tasting these waters would note the presence of any peculiar flavor. Numerous analyses have been made, of which we give several below:

In 1856 Professor E. H Larkin, of St. Louis, made a quantitative analysis of the waters, at a temperature of one hundred and forty-five degrees. He found eight and a half grains of solid matter to the gallon, which was thus distributed:

	Grains.
Silicic acid	24.75
Sesqui oxide of iron	1.12
Alumina	5.15
Lime	28.83
Magnesia	.73
Chlorine	.7
Carbonic acid	21.36
Organic matter	8 31
Water	1.72
Sulphuric acid	4.40
Potash	1.46
Soda	2.01
Iodide and bromide, a trace	
Total	100.08

ANALYSIS BY THE STATE GEOLOGIST.—The following is extracted from the reports of Professor David D. Owens, late Geologist of the State of Arkansas. It embraces the most recent quantitative analysis made by competent authority:

Silicate with base.	Bi-Carbonate of lime.
Bi-Carbonate of magnesia.	Alumina with oxide of iron.
Carbonate of soda.	Carbonate of potash.
Sulphate of magnesia.	Chlor. of magnesia.
Oxide of magnesia.	Sulphate of lime.
Bromide, a trace.	Organic matter, a trace.

"The waters are thoroughly impregnated with free carbonic acid.

"In June of 1858 I made a partial examination of the waters of the Hot Springs, by boiling down one and a half gallons of the water, and found the contents, approximately reduced to one gallon, as follows:

	Grammes.
Organic matter combined with some moisture	1.16
Silica, with some sulphate of lime not dissolved by water	1.40
Bi-Carbonate of lime	2.40
Bi-Carbonate of magnesia	0.50
Chloride of pottassium	0.04
Chloride of sodium	0 218
Oxide of iron and a little alumina	0.133
Sulphate of lime dissolved by water	0.350
Loss, Iodine? Bromine?	0.053
Total	6 254

We also quote a few lines from an essay on these springs and their effects by Dr. Garnett:

Prof. Cabell, of the University of Virginia, whose opinion on any subject which he may investigate is entitled to the highest respect, in an article on the Hot Springs of Virginia, published in the *Richmond and Louisville Medical Journal*, says: "I do not believe that ordinary hot water will produce such results. * *

"It cannot be owing to the dissolved mineral matter, for similar or even identical effects are observed at the most highly mineralized thermal springs, and at those which contain no more mineral matter than is found in ordinary drinking water. It is pure speculation without a shadow of positive proof to affirm, with Dr. Granville, that telluric heat has a peculiar caloricity, or with Lersch, a practitioner at Aix-la-Chapelle, that thermal waters may be more highly charged with electricity, or with the late Dr. James Johnson, of London, to refer the effects to 'the greater degree of solution and intimate union which the mineral principles in thermal springs possess when flowing out of the soil, where they have been kept in combination for years. But whether a satisfactory solution of the mystery be ever discovered or not, the *fact is*, that this difference between *thermal* and ordinary heated water is seldom or never questioned by competent judges, who have examined the question without bias or prejudice.'"

Since the above was penned by its distinguished author, some experiments have been made by Drs. Heyman and Krebs, showing the electrical effects on the magnetic needle, of the contact of water charged with gases, acids, or salts, with distilled water, with the following results:

"1. Distilled water with other distilled water, produces a current when the temperature of the *two differs*, the *warm* water representing the positive pole.

"2. Distilled water which has stood for some time in a closed vessel, in contact with freshly distilled water, showed a deflection of 20°, the water containing air being positive.

"3. Distilled water with water containing oxygen, causes at first a deviation of 20°, permanent at 20°; containing carbonic acid gas, first deviation, 85°, permanent at 21°. The water containing gas is always positive. Water acidulated with nitric, sulphurous, or hydrochloric, acid acts positively and produces considerable deviations.

"Water containing alkalies, acted negatively; containing hydro-sulphuric acid, it also acted negatively; containing acid salts, it acted positively; containing neutral or basic salts, it acted negatively."

"I have introduced these experiments to show the large quantity of electricity, with which water is charged when it has a high temperature, and contains a mineral matter. It is *conceded* that water terrestrially heated is charged with a larger quantity of electricity than that which has had its temperature, artificially raised, and upon this fact, I base, in part, the curative value of thermal waters."

Most writers on thermal springs believe that their chief efficacy depends upon temperature, and it seems more than likely that such is the case here. After three days of exploration and entertainment by the hospitable people of Hot Springs the party returned home well repaid for the time given to the excursion.

PROFESSOR THEO. G. WORMLEY, M. D., late Professor of Chemistry in Starling Medical College, at Columbus, Ohio, has recently been elected Professor of Chemistry in the University of Pennsylvania, an institution where he received the degree of M. D. less than twenty-five years ago. Prof. Wormley has been a most ardent and devoted student all his life, and has achieved a reputation as a chemist second to none in the country. His principal work, upon the "Microscopy of poisons," is one of the most exhaustive treatises ever written on toxicology, and is regarded as the standard authority on the subject. His accomplished wife assisted him most materially in the preparation of this work by executing with her own hands the steel plates from which the beautiful engravings illustrating the work were reproduced, after all other engravers had declined the undertaking.

PROF. BROADHEAD writes from Pleasant Hill: An Aurora, not very bright, was visible here at 8:30 P. M., May 28th, extending probably 45° high and 60° east and west.

BOOK NOTICES.

DICTIONARY OF SCIENCE, comprising Astronomy, Chemistry, Dynamics, Electricity, Heat, Hydrodynamics, Hydrostatics, Light, Magnetism, Mechanics, Meteorology, Pneumatics, Sound and Statics. Preceded by an Essay on the History of the Physical Sciences. Edited by G. F. RODWELL, F. R. A. S., F. C. S. With numerous illustrations. 694 pages, octavo. Philadelphia: Henry C. Lea.

This comprehensive work is confined strictly to the exact sciences, and forms a most complete and useful cyclopedia of information to the student and working man in every department of practical knowledge. The names of Proctor, Crookes, Bottomley, Guthrie, Rodwell, Tomlinson, Wormell, Barrett, Heaton and Atkinson, as contributors in their special branches of science, is a guaranty that the work is profound, accurate and exhaustive.

The Essay upon the History of the Physical Sciences is most interesting and valuable, beginning with the Physical Science of the Ancients, taking up, in turn, that of the Middle Ages, that of the Sixteenth Century, the Mystical Philosophy of the Seventeenth Century, the Physical Science of the Seventeenth Century, the Age of the Physical Sciences and the Study of the Physical Sciences.

The object of the work is stated by the editor to be the interpretation of nature's secrets, simplified and popularized, stripped as far as possible of abstruse treatment and difficult formulæ, and this has been done remarkably well, not only by the manner in which the various subjects have been treated by the writers themselves, but by the arrangement under proper heads, by frequent cross references, and by breaking subjects up into various sub-heads.

We have already found the articles on Astronomy, Electricity and its kindred topics, and Chemistry of great use in our work, and shall keep the book on our table for frequent reference.

For sale by MATT FOSTER & Co., $5.00.

ANNUAL REVIEW OF SCIENCE AND INDUSTRY for 1876. Edited by SPENCER F. BAIRD. Harper & Bros., New York. For sale by MATT FOSTER & Co., $2.00.

This most valuable work has been received too late for such extended notice as it deserves. We can only say at present that it is the most complete record of the progress of science that has ever been made by any one, and is the best of the whole series which Prof Baird has been editing for the past six years.

BOOKS AND PAMPHLETS RECEIVED.—Rodwell's Dictionary of Science; Annual Record of Science and Industry for 1876; Popular Science Monthly for June, 1877; Nos 2 and 3 of the Publications of the Cincinnati Observatory on the Micrometrical Measurements of Double Stars; Telegraphic Journal, London; Journal of Applied Science, London; Popular Science Monthly Supplements, Nos. 1 and 2, Appleton & Co.; Van Nostrand's Eclectic Engineering Magazine, June, 1877, 96 pages, octavo, $5.00 per annum; History and Transactions of the Editors' and Publishers' Association of Missouri, for 1867 to 1876, compiled by J. W. Barrett; Catalogue of Lincoln Institute, Jefferson City, Mo.; Catalogue of the University of Cincinnati, Ohio, for 1877–8; The Jeweler, Silversmith and Watchmaker, Philadelphia, June, 1877; Iron Age, weekly, New York, May 24, 1877.

THE

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MINERALOGY.

THE IOLA (KANSAS) MINERAL WELL.

BY PROF. WILLIAM K. KEDZIE.

Prepared for the Semi-Annual Meeting of the Kansas Academy of Science, Leavenworth, June 1877.

At the request of the proprietors, I visited this interesting phenomenon during the month of June 1876, for the purpose of collecting a supply of water for a thorough analysis. The so-called "well" is, as is well known, simply an old boring by coal prospectors. Its total depth is 736 feet. When at the depth of 626 feet the diamond drill with which the boring was made, suddenly dropped some twenty inches through an apparently vacant seam. A violent upward rush of water and gas immediately began through the tube, and with more or less irregularity has since continued without cessation. The boring is tubed to the depth of 149 feet only. The water is expelled by the elastic force of the gas in very irregular pulsations, at varying intervals escaping alternately first with great impetus and then with a succession of fainter impulses. The sections of the core obtained during the boring present, when arranged in order, a most interesting view of the geological section of this region; especially instructive as it occurs over the Lower Coal Measure area of this State. The water of the well is, of course, largely charged with mineral matters, a portion of which being held in solution by the free carbonic acid with which the water abounds, is deposited as a thick sediment upon allowing the water to stand for some time freely exposed to the open air. By repeated and careful experiments, I determined the temperature of the water to be uniformly 61° F., as from the great depth from which the water rises it exhibits little or no variation in temperature through summer or winter. A full analysis of the water presents the following results: Specific Gravity, 1.0138. Temperature, 61° F. Total Mineral Matter to the Imperial Gallon, 1100.081 grains. Carbonic Acid Gas, 145.891 cub. in.

Sodium Chloride	971.506	grains.
Potassium "	17.909	"
Magnesium "	7.305	"
Sodium Bi-Carbonate	8.158	"
Calcium "	60.687	"
Magnesium "	25.485	"
Iron "	3.929	"
Silica	.602	"
Sodium Iodide	Distinct	Traces.
Sodium Bromide	Abundant	Traces.
Organic Matter	2.000	"
Suspended Matter	2.500	"
Total	1100.081	"

The results of the above analysis have been in all cases duplicated, and in many cases triplicated. Like the product of all mineral wells, this water of course varies somewhat, within slight limits, in its composition. Thus in the water examined by me there was absolutely no trace whatever of sulphates, whereas I observe that Prof. G. E. Patrick in his paper read before the Academy last year, reports the presence of a very small quantity of Sodium Sulphate. I notice, however, that Mr. Patrick also reports in his analysis an appreciable quantity of Ferric Chloride (Sesqui-Chloride of Iron). If this salt of iron is indeed present in this water it is a most remarkable fact, as there is no well authenticated analysis showing its existence in any mineral spring in the United States. My own analysis indicates no such condition, the iron being present in the water analysed by me in its usual form in all mineral waters, viz. held in solution as the Bi-carbonate. For the purpose of comparison I give below a tabular view showing the composition of the Iola water as contrasted with that of two of the most noted of the Saratoga Springs, the "Congress" and the "United States:"

IN GRAINS TO THE IMPERIAL GALLON.

	Iola.	Congress	United States.
Bi-carbonate of Sodium	8.158	7.472	3.240
" " Calcium	60.687	99.592	64.672
" " Magnesium	25.485	72.152	43.192
" " Iron	3.929	.248	.520
" " Lithium		2.992	3.040
" " Barium		.760	.752
Chloride of Sodium	971.506	400.440	141.872
" " Potassium	17.909	8.048	8.004
" " Magnesium	7.305		
Sulphate of Potassium		.888	
Phosphate of Sodium		.016	.016
Iodide of Sodium	Traces	.136	.048
Bromide of Sodium	Traces	8.552	.848
Alumina		Traces	.096
Silica	.602	.840	3.184
Organic Matter	2.000	Traces	Traces
Carbonic Acid Gas (cub. in.)	145.891	432	240

The Iodide and Bromide of Sodium, though in minute amount, are present in very appreciable quantities in the water of the Iola well, and to their influence is undoubtedly due much of the asserted beneficial effects of this water upon scrofulous and other allied difficulties. The Carbonic Acid present in the Iola water is considerably less than that afforded in the waters of the Saratoga springs, though an abundance is present to remove, by its sparkling influence, much of the disagreeable flavor of the water, which otherwise, from the large amount of mineral matter present, might prove somewhat unpleasant.

The gas, which is thrown from the well with such force and in such quantity, is almost wholly made up of Light Carburetted Hydrogen, commonly known as "Marsh Gas." From its very slight solubility (1 part in 27 by volume, Storer), it of course exists in very small quantities only in the water itself, though it is constantly bubbling up through it. Notwithstanding the views of many observers and writers, the escape of this gas in such abundance from this well is neither anomalous or startlingly unusual. It is no uncommon occurrence in many portions of the country in sinking similar borings for coal, salt or oil, to find this gas suddenly escaping with force sufficient to stop or reverse the engine. This Light Carburetted Hydrogen is produced in immense quantities in nature from the slow decomposition of all deposits of vegetable matter, and frequently escapes naturally in great abundance. The large supply of this gas near Fredonia, N. Y., by which the entire village is lighted, is too well known to need comment here. Near Oberlin, Ohio, is a spring from which I have frequently discovered the gas escaping in great quantity, forming, when lighted, a flame of large size. Near Kanawha, Va., and at many other places too numerous to mention, this same gas has been known to escape for years without cessation. It is this gas which constitutes the dreaded "fire damp" of our coal mines, the cause of all the terrible disasters and explosions with which the history of coal mining is filled. Points from which it escapes in much the same manner as at Iola, without the efflux of water, are known to the miners as "blowers," and are liable to suddenly appear at any time upon opening a new seam.

Nor, upon the other hand, is it at all necessary, in endeavoring to explain the origin of such large quantities of this gas as escape from the Iola boring, to resort to the popular but very improbable hypothesis of the decomposition of the coal itself by the agency of heat; especially inapplicable to this uniformly undisturbed portion of the Lower Coal Measure of Kansas. There is no evidence to show that this vacant seam of 20 inches encountered at this great depth was originally occupied by a coal bed at all, and such a supposition is not in any way essential. There can be no doubt but that this opening, whether produced by flexure of lower strata or otherwise, communicates laterally with a very large tract of coal bearing formations, possibly with a good portion of the Western Interior Coal Area. And when we remember the fact that this Light Carburetted Hydrogen is given off in large quantities from many varieties of bituminous coal at *ordinary temperatures*, we need be at no loss to account for its appearance at this opening in such considerable amount. It is from this cause that the gas accumulates in coal mines in such dangerous quantities; and it is by no means impossible that this Iola boring may serve as the "vent hole" for a considerable area of coal bearing territory. This escape of Light Carburetted Hydrogen from soft bituminous coal at ordinary temperatures is of course a continuation of the original coal forming process: a slow decomposition of vegetable matter under a very limited supply of atmospheric oxygen, in which the gaseous products are principally Light Carburetted Hydrogen with Carbonic Acid (di-oxide), small portions of Carbonic Oxide and occasionally still smaller quantities of free Hydrogen. The appearance of the Light Carburetted Hydrogen in so liberal quantities at the Iola well, as also the composition of the water brought up by the pulsations of the gas itself, are both matters of very great scientific interest; but neither their interest nor their importance are in any way augmented by ascribing miraculous properties to the one or an anomalous origin to the other.

PRECIOUS STONES.

The same love of brilliancy which in childhood is manifested by a desire to grasp the flame of a candle or any other shining object, in more mature age is indicated by a love for gems. Although, at present, the value of gems depends solely on their use as ornaments and on their usefulness as parts of a few delicate instruments, the ancients regarded them in an entirely different light. To gems were formerly attributed the most extraordinary powers; they were believed to be efficacious in preventing disease, in averting all sorts of calamity and misfortune and in frightening away all sorts of evil spirits, gnomes and hobgoblins. It was even believed that a man's fate might be decided by a precious stone carried about the person. Although these views seem absurd and preposterous now, they were thought to be very reasonable then and fully accorded with the spirit of the age. The transcendentalists of those days who insisted that one great Spirit animated the universe, found no difficulty in believing that jewels were possessed of souls, a belief assisted by the extraordinary play of colors and the wonderful sparkling brilliancy which some displayed, both in sunlight and by artificial illumination.

In almost all ages jewels of various kinds have played a part in religious rites. Even so refined a religion as that of the Jews made great use of precious stones in the dress of the priests. Aaron's ephod was ornamented with two onyxes engraved with the names of the twelve tribes, while the breast-plate was set with twelve jewels, which, according to the traditions and to the authority of the most celebrated rabbis and doctors, were the cornelian, topaz, emerald, ruby, sapphire, diamond, hyacinth, agate, amethyst, chrysolite, sardonyx and jasper. The internal evidence of the Book of Job shows considerable knowledge not only of geology, but of metallurgy, and he mentions by name a number of the most valuable gems. The Book of Revelations in the New Testament abounds with references to the various kinds of precious stones, and almost every kind is mentioned in the gorgeous imagery employed by John to describe the new Jerusalem. Astrological mineralogy, properly speaking, had its origin in Chaldea. There first a list of stones was made out, and each assigned its proper healing or beneficial office. In time one gem was appropriated to each sign of the zodiac. Amulets of twelve stones were made so that the wearer could always have an antidote at hand for danger in every time of the year. The garnet was for January, the amethyst for February, the jasper for March, the sapphire for April, the agate for May, the emerald for June, the onyx for July, the cornelian for August, chrysolite for September, aquamarine for October, topaz for November, and ruby for December.

Cardan, a celebrated authority on the mystical properties and virtues of jewels, who wrote as late as the sixteenth century, has much to say of the manner of the origin of precious stones. In his opinion precious stones are caused by certain essences or juices which flow from grosser substances. The diamond, the emerald and the opal he supposed to come from the essence of gold; the sapphire from silver, and the carbuncle, the amethyst and the garnet from iron. He admitted, without question, that precious stones not only lived, but that they suffered illness, old age and death.

"He then speaks of the different virtues possessed by precious stones. The hyacinth preserves from thunder storms and pestilence, and induces sleep. This quality was attributed to it by Albertus Magnus. Without precisely rejecting this notion, Cardan confesses that he carries ordinarily a very large hyacinth, and that it has never appeared to contribute anything toward making him sleep; but he adds immediately, and with perfect naivete, that his hyacinth has not the true color, and may possibly be far from good. It was also believed that the hyacinth increased riches, augmented power, fortified the heart and brought joy to the soul. He describes the turquoise which, mounted in a ring, secures the horseman from all injury if he falls from his horse; and adds: 'I have a beautiful turquoise which was given me for a keepsake, but it has never occurred to me to test its virtues, as I do not care, for sake of the experiment, to fall from my horse.' Babinet says: 'For all maladies of a nervous or moral nature, where imagination might exert a great influence, precious stones were certainly a sovereign remedy. In saying to such an invalid that an emerald placed under his pillow would drive away melancholy, dispel nightmare, calm the palpitations of the heart, induce agreeable thoughts, bring success to enterprises, and dissipate the anxieties of the soul, a cure was certain to be effected simply by the faith which the invalid had in the efficacy of the remedy. The hope of cure in such affections is the cure itself, and in all the numerous cases where the mind has had an influence upon the bodily system, the imaginary cause must produce a very real effect. Finally, that eternal deception of the human spirit, which registers all the cures, but does not take into account the cases where the curative means have failed of their end, contributed to maintain a belief in the occult virtues of precious stones. It is not half a century ago since sufferers would borrow from rich families gems mounted in rings, to apply to the affected parts. When the trinket was introduced into the mouth as a cure for toothache, sore throat or ear ache, the precaution was taken to secure it by a strong string, lest it should be swallowed by the patient."

The earliest diamond mines were those of Golconda, in India. For many years they furnished employment for thousands of people, and though now they are exhausted, their products glitter in every coronet in the world. In modern times the mines of Brazil have furnished annually $4,000,000 or $5,000,000 worth to the world, and constituted the principal source of supply till eight years ago, when diamonds were discovered in abundance in South Africa.

"The South African diamonds are found over many hundred square miles of territory. The principal diggings are situated in the valley of the Vaal river, to the northeast of the Orange River Free State, and within the boundary of the Cape Colony as now defined. The country here rises into long stony ridges, consisting of irregular fragments of hard rock imbedded in ferruginous gravel, which varies in character and compactness, being sometimes quite loose, and sometimes forming a compact lime-cemented mass. It is in this gravel that the diamonds are found. They occur at various depths down to twenty feet or more, but the usual depth is from two to six feet below the surface. The manner of work is simple enough. A claim or piece of ground, thirty feet square is occupied by two diggers in partnership, assisted by their black servants. They remove the loose blocks of stone, which are cast aside; they take up the gravel and sift it thoroughly, either in a dry state or with abundance of water in a sieve rocked by a cradle. When the pebbles have thus been separated from the sand they are cleansed and placed upon the sorting table to be carefully examined for any diamonds that may lie among them. The mines were pronounced the richest in the world. Diamonds weighing from twenty to thirty carats were not unusual; and among the exceptional treasures found were diamonds weighing considerably more than 100 carats, including the beautiful 'Star of Beaufort,' and the 'Star of Diamonds,' weighing 107½ carats; and a lovely stone, which attracted especial attention by exhibiting under the microscope an aspect of pointed mountain summits, lighted by vivid sunlight with all the colors of the rainbow."

"One of the most celebrated diamonds is that of the Rajah of Matteen, in Borneo. It was found on that island, and weighs 318 carats. It is shaped like a pear, and is considered by the people of Borneo as a kind of palladium to which the destinies of the empire are attached. They attribute to it the miraculous power of curing all diseases by means of the water in which it has been dipped. According to Jamieson, the Governor of Borneo offered for it $150,000, two large war brigs, with their guns, ammunition and stores, and seventy cannon, with a large quantity of powder and shot; but the Rajah refused to part with it. The story of the celebrated Regency diamond is told by St. Simon, who professes to speak of his own personal knowledge. He says that the diamond was stolen by a person employed in the diamond mines, who escaped to Europe with it, and after showing it to several princes—and among the rest to the King of England—passed over to Paris, and showed it to the somewhat notorious Law. Law proposed to the Regent that it should be bought for the King, but the state of the finances was such that the Duke hesitated to spend such a large sum in that way. St. Simon lent his influence in favor of the purchase, representing that the diamond was peerless in Europe, and would well become the crown of France, and that the purchase of it would shed glory on the regency of the Duke. The latter at last consented, and the diamond was bought for $384,000, others say $648,000, the seller receiving also the fragments resulting from the cutting, with interest on the price till the whole was paid. From that time the Regent became identified with the fortunes of France, and a chapter of historic details belongs to its career. It has passed through many revolutions, and it has passed literally through many hands, for in the days that followed the fall of Louis XVI, the Regent, carefully chained and guarded by gens d'armes, was exposed to the people of Paris, and any half-starved workman who chose might hold this symbol of royal splendor and epitome of twelve million francs for a few moments in his brown hands. The Regent, pawned to the Batavian government by Napoleon I, stolen by robbers, and its hiding place revealed at the gate of death by one of the reckless band, and mounted in the State sword of the First Napoleon, finally glittered in the imperial diadem through the palmy days of Napoleon III."

The adventures of the Kohinoor, how it passed from one hand to another, how it was made the pretext for fraud, for intimidation, for murder, and even for war, are all so well known that their recapitulation is useless here.

"When the Kohinoor was brought to England it weighed 186 1-16 carats, and was valued at abont $700,000. At that time it was merely surface cut, and was also disfigured with several flaws, so that recutting seemed advisable; and it was decided to give it the form of the brilliant. The cutting was begun on July 16, 1852, the Duke of Wellington being the first person to place it on the cutting mill, and was finished September 7, thus occupying in all thirty-eight days of twelve hours each. In cutting its weight was reduced to 122¾ carats, but the stone is nevertheless valued at the same price it was before, on account of the improvement in brilliancy and effect. Besides the Kohinoor and a great number of fine pearls, the crown of Queen Victoria contains 497 diamonds, of which the value is estimated at more than $372,000."

"The country most rich in diamonds at present is Russia. Besides special collections of diamonds in the treasury of this empire, there are three crowns of which they form the sole jewels. The first, that of Ivan, contains 881; that of Peter the Great, 847; and that of Catherine the Great, 2,536. Among the large diamonds in Russia the most remarkable is the Orlow. It weighs 193 carats, and is one of the ornaments of the imperial scepter. This beautiful diamond was originally from India. It formed for a century and a half one of the eyes of the famous idol of Serringham, in the temple of Brahma; the other eye was a diamond of the same order. At the commencement of the eighteenth century the idea seized a French soldier of one of the French garrisons in India, to steal the eyes of this celebrated idol. He pretended to be inspired with a wonderful zeal for the Hindoo religion, and gained to that degree the confidence of the priests that they confided to him the care of the temple. He chose his time, and one stormy night, carried off one of the diamonds; the other could not be freed from the socket. He fled to Madras, where he sold the stolen treasure to a Captain of the English navy for $9,300. Conveyed to England it was bought for $55,800 by a Jewish merchant, who some time after sold it to Catherine II for $418,500 and a pension for life of $18,600. A precious stone without rival is the blue diamond of Mr. Hope. Its weight is 44½ carats, and its color is the blue of the most beautiful sapphire, added to an adamantine luster of the utmost brilliancy. It was purchased for $83,700, but competent judges declare that it is worth more."

The classification of jewels by the author arranges all precious stones in three classes. The first comprises a single stone—the diamond—which is composed only of carbon. The second comprises all jewels the base of whose composition is alumina. The list of these is much more varied than might be supposed, since it contains stones as varied in appearance and color as the sapphire, the ruby, the Balas ruby, the Spinel ruby, the topaz, the emerald, the beryl, the aquamarine, the cymophane and the turquoise. Alumina is the base of the common red and yellow clay which is found everywhere in the utmost abundance, and the only mark of distinction known to chemists between the common clay and the sapphire, or the emerald, is the fact that the latter are crystalized, and contain traces of metalic oxides which give color to the stones. The name corundum is applied by mineralogists to all varieties of crystalized alumina, whatever their color. Colorless corundum is so brilliant as sometimes to be mistaken for a diamond, but it may be readily distinguished by its double refraction, and by its small specific gravity. The corundums are often exceedingly valuable, rubies of perfect luster and purity being of greater value than diamonds. The ruby ranks first for price and beauty among all colored stones. It is of the pure red of the spectrum, and next after the sapphire is the hardest of precious stones, always excepting the diamond. Charles Achard, the highest authority in France in all that concerns the traffic in colored stones, remarks that weight has not the same effect in their case as in that of the diamond. Every diamond, from the very smallest specimen upward has its value, like gold and silver, according to weight; but in the case of rubies and other gems, the little specimens have hardly any value, and these stones only begin to be appreciated at the moment when their weight withdraws them from the common lot, and assures at once their rarity and high price. When a perfect ruby of five carats enters the market, a price will be offered for it double the price of a perfect diamond of the same weight; and if a ruby reaches the weight of ten carats, it will bring triple the price of a diamond of the same weight (from three to four thousand dollars). The carbuncle of the ancients is the same as our modern ruby. The most fantastic qualities were formerly ascribed to these wonderful stones. The carbuncle served to furnish light to certain great serpents or dragons when old age had enfeebled their eyes; they constantly carried these magical stones between their teeth, only dropping them when it was necessary to eat and drink. According to St. Epiphanius, the carbuncle has not only the property of shining brilliantly in darkness, but its light is of a nature so extraordinary that nothing can arrest it, so that it shines, for instance, through vestments with undiminished fire.

Stones composed in whole or in part of silica are much more numerous, and much less valuable than the aluminous stones. Quartz, transparent and colorless, is the purest specimen of silica that can be obtained; and though when colored by the mixture of other ingredients it receives a variety of names, it is no more changed in nature than would be the pieces of the same silk which had received each a different color from dyeing.

"Crystals do not ordinarily attain large dimensions. For the greater number of minerals, crystals of two inches are almost gigantic; few, indeed, exceed four inches in height. Quartz, however, forms an exception to this rule. Specimens are brought from Madagascar more than twelve inches in length and remarkably pure and transparent, notwithstanding their great size. The rock crystal of this island is used for the object glasses of astronomical telescopes. Magnificent crystals have also been found in the Alps; one of these Alpine crystals, taken in Italy by the French, was borne in triumph to Paris in 1797. There is a beautiful specimen in the Museum of Natural History at Paris, which measures three feet every way, and weighs nearly 800 pounds. At the French Exhibition of 1866, in the sections of Japan and Brazil, there were some wonderful crystals. One brought from Brazil weighs 212 pounds, is $2\frac{1}{2}$ feet high, 1 foot in diameter, and is a perfect six-sided prism. A remarkable phenomenon in quartz is exhibited by the fluid drops contained in many specimens. Sir David Brewster ascertained that the fluid is not water, but of an oleagineous nature, one part volatile at 27 degrees, and the other a fixed oil. Dana has named the former cryptoline and the latter brewsterine. Some beautiful specimens of quartz crystals, beaded with those imprisoned drops, have been found at Trenton Falls.

"Quartz has but little value of its own; but when it is made into vases, cups and other artistic objects, it acquires a high price. The Athenians produced some exquisite works of art in rock crystal, and the Romans valued it very highly in the form of vases. Nero had two cups of it, which he broke in his rage, when he heard of the revolt that caused his downfall. One of these cups was estimated at over $1,900. The *elegants* of Rome were in the habit of using balls of rock crystal to cool their hands, and certain occult charms were also said to reside in these smooth, cold globes. In the middle ages the Venetians produced some beautiful objects in rock crystal; and Milan has long been famous for its statuettes, vases and girandoles of this material. But desire of gain has deteriorated the artistic value of these productions. Cut crystals have come to be sold by weight, and the cutting is naturally falling into neglect. In the Cathedral at Milan the burial shrine of St. Charles Borromeo is wholly formed of plates of rock crystal of six or eight inches square each, set in a framework of silver. The shrine was the gift of Philip IV of Spain, who employed eight years in collecting the necessary quantity of rock crystal."

"When crystals of quartz are found combined with certain traces of coloring matter, they constitute distinct species in commerce, and take completely different names. Combined with iron and alumina, quartz becomes yellow and takes the name of the Bohemian topaz. Impregnated with a bituminous substance it becomes more or less darkened, and is called the smoky topaz. Combined with a slight proportion of oxide of manganese it takes a beautiful violet color; it is then the occidental amethyst. Colored blue by iron and alumina it becomes the water sapphire. Colored rose by iron and manganese, it is the Brazilian ruby. Combined with a notable proportion of oxide of iron, it becomes a brown red, and constitutes the hyacinth of compostella. But among all these varieties, there are only two that are really valuable, the amethyst and the water sapphire. The amethyst of commerce to-day is mostly furnished by Brazil. In that part of the world amethysts attain to an enormous size. A block of amethyst, sent from Brazil to Calcutta, is said to have weighed ninety-eight pounds. Some of the Brazilian specimens are of two colors. Count de Bournon possessed a cut and polished stone of this kind, half violet and half yellow. The ancients believed that wine, when drunk from an amethyst cup, lost the power of causing intoxication. Accordingly the attributes of Bacchus are frequently found engraved upon ancient cups of amethyst."

Under the name of false jewels are comprised three kinds of articles, the first being stones sufficiently hard to resist a file, the second being artificial productions of the nature of glass, and the third being what are called doublets.

"It is of some importance to examine this subject, because there is a prevalent belief that all false stones necessarily have glass as their base, and aré consequently of little hardness. People often say when their rubies or their topazes are declared false, 'But, see, here is a file; try to scratch these stones, you will not succeed.' Very true, but submit any piece of quartz to the same test, and the result will be the same. Since, as we have said, hyaline is very abundant in nature, it is easy to procure, at insignificant prices, stones that perfectly resist the file, and show, often in a remarkable manner, the whole series of colors that we admire in real precious stones. The colorless varieties of sapphire and topaz which in density, in hardness and in refractive power differ but little from the diamond, are frequently cut into roses and brilliants and sold for diamonds. A proof of this fact is furnished by the commercial price of the colorless topaz, which is much is much greater than it could obtain as topaz. It is valued in the secret hope that after cutting it may be sold for diamonds. The doublet method of imitating precious stones, though varying in a great many respects, is generally effected by giving the proper shape to a morsel of strass (a peculiar kind of glass), removing from the upper portion of it a certain thickness and replacing this by hard stone, in such a way as to complete exactly the strass stone, then mounting the whole in a setting that completely conceals the line of junction of the two stones. Doublets are of two kinds—in both the under part is strass, but in one the upper part is a plate of the real stone, in the other it is simply hard stone, generally quartz, and of no value. The description of the method of manufacture in the fifteenth century is given by Cardan, who has even preserved for us the name of the inventor. A fraud of a very bad character, and one very difficult to find out, was employed by Zocolino. This venerable personage used to take a thin flake of real precious stone, such as carbuncle or emerald, choosing such pieces as had but little color and were consequently very cheap. Underneath he placed a piece of crystal, sufficiently thick, and united in two parts by means of a transparent glue, in which he incorporated a coloring matter in harmony with the stone he meant to represent, brilliant red for carbuncle and green for emerald. He concealed the line of junction of the two parts by means of the setting, and to avoid giving rise to suspicion he set them in gold, which was not allowed except in the case of real precious stones. In this way this magnificent workman deceived everybody, even the lapidaries. However, the fraud was at last discovered, and Zocolino took refuge in flight. It appears that this person had a peculiar disposition for fraud, for he turned his attention afterward to the fabrication of counterfeit money, and ended by being condemned to death. An examination of the objects adorned with precious stones that were executed in the middle ages, shows that the process described by Cardan was not unfrequently employed."—*Globe Democrat.*

MICA AND ITS USES.

Mica, from the Latin "to shine," is composed of silex, alumina, and potash. It is found in almost every country on the globe—America, Switzerland, Siberia, Norway, Bohemia, and Russia. Siberia and the United States probably furnish the best and largest specimens. It occurs in granite and quartz, also in rubellite, green tourmaline, feldspar, lepodolite, and several other minerals. It is one of the constituents of granite, gneiss, and mica schist, talc-slate, etc. It sometimes occurs in granular limestone, and rarely in lava, dolomite, and magnetic iron ores. According to Dana, mica is usually in thinly foliated plates or scales; color from white, through green, yellowish and brownish shades, to black; with a pearly lustre, transparent or translucent; before the blowpipe infusible, but becomes opaque white. There are a number of varieties. That in which the scales are arranged in plumose form is called plumose mica; that in which the leaves or scales have a transverse cleavage is called prismatic mica. The crystals are chiefly rhombic, or six-sided, though not always. The cleavage of mica is highly perfect, and, according to Professor Henry, it can be split or divided into leaves 250,000 to the inch. It shows a tendency to associate with quartz, and in the mines recently discovered in New Mexico a coarse quartz mixed with fine white crystal formation is the sign of the mica mine. Many deposits or veins have been discovered in San Juan during the winter, but a very small per cent. carry mica of a merchantable quality; the cleavage is generally transverse, or foreign coloring matter enters into it to such an extent that it is worthless for market. The uses of mica are various. Diamond dust, with which court dames and our own American ladies powder their hair, is ground mica. The costly French silver mouldings are cast from ground mica. The wonderful showers of diamonds I have witnessed in the scenic plays of the "White Fawn" and the "Black Crook," at Niblo's, were mica scales. As a lubricator it is perfection. Mixed with oil it wears longer than any other ingredient. Recent experiments have shown that for any swift-running machinery, where the Babbit metal and other packing have proved at fault, mica packing is perfect; being indestructible by heat, it generates none, and as soon as a good Yankee test is made, the result will be mica-packed boxes for fast, heavy-running machinery, and no more hot boxes or worn journals, being entirely free from grit. For stoves it has now become indispensable, and the demand for clear, transparent mica is rapidly increasing. We have opened five mines during the past three months, and out of over forty veins which I have examined since last November, these five are the best. The quantity which these mines can produce is unlimited, and the quality equal to any in the United States. I have carefully compared it with mica from the mines of North Carolina, of S. Royalston, N. H., and of Paris, Maine, where mines are now being worked; from what I learn of mines in other parts of the United States and over the water, I am led to believe that we have a much larger deposit and of larger sizes than is now found in this or any other country. Large plates, when they could be procured, were at one time used in the Russian naval vessels for deck or dead lights, because not liable to fracture from concussion. It is in common use for lanterns, and is rapidly coming into use for lamp chimneys. On account of its transparency and toughness, and the thinness of its folia, it has been used as glass in Siberia, but is now too costly for common use. It is not difficult to find mica in the district in which our minerals are located, but after many months spent in prospecting, exploring, and working, I find that to find the perfectly clear, transparent, flexible mica, free from color, veins, curves, and other imperfections, is very difficult. Sizes as large as 14 inches have been found in North Carolina. We have not unfrequently sized from 18 to 24 inches. Last week we took out one book or crystal weighing fully one hundred pounds. We are now able to furnish mica by the ton. Crude mica, *i. e.*, pieces too small for cutting, and the cuttings are too far from market, and the uses of waste mica too limited, to render them valuable. Sizes less than $2\frac{1}{2}$x4 or $4\frac{1}{2}$ inches are hardly worth saving. Sizes 5x7 and 9 inches are worth $6.50 to $7.40 per pound, with a rapid increase in price for larger sizes. I made an extended tour of observation through New Mexico with Governor Hunt and Colonel C. B. Lamborn, of the D. and R. G. railway a few weeks ago, and returned to our mines fully satisfied that the small district in which we are now operating contains about all there is worth looking for in that line in that territory. Small deposits or veins are often found at a distance from us, but after a thorongh investigation and an expenditure of labor and money, have been abandoned, the quality not proving satisfactory, The mica which I have so far exhibited from our mines has all been taken from within one to three feet from the surface.—J. Cary French.—*Journal of Applied Science.*

ARGENTIFEROUS MUD.

The report made recently that in the Lake District of the San Juan mining region there had been discovered a yellow mud lying in a crevice in the pay streak, about an inch and a half wide, which assayed from one hundred to four hundred dollars in gold, and from two hundred to two thousand dollars in silver per ton, recalls and gives plausibility to the statement published in the San Francisco *Examiner*, within a few months past, that in Wasco county, Oregon, there is a flat thickly studded with springs of a peculiar character, that throw out mud which has overflowed a considerable area. Some months ago it was reported that this mud had been discovered to be argentiferous and very rich, some specimens assaying over $2,000 to the ton. Prof. Hanks intimates that the flow of the Oregon mud springs is in reality heavily impregnated with silver, and this result he announced in a paper read before the California State Geological Society last Tuesday evening. The existence of springs yielding soft mud, charged with free silver, says Prof. Hanks, is new to science, and scientific men, both here and at the East, who examined specimens, pronounced them fictitious without hesitation. The specimens latterly examined by Prof. Hanks, he says, were very rich, and silver was discovered in a free state. By simple washing the silver could be wholly separated, and when then examined the microscope failed to reveal the source of the precious metal. Had it been filings, a single glance would have sufficed to detect the fact. Had the silver been precipitated from solution by copper it would have been crystalized. An amalgam of silver and mercury would have yielded a sublimate if strongly heated in a glass tube closed at one end. Such an amalgam introduced into the wet mud, and the whole heated sufficiently to have volatilized the mercury, would have left the substance in a hard, baked state, which could not again have been reduced to the state in which it reached this city. From these conclusions, if the silver had been introduced for fraudulent purposes, the substance was very remarkable, from the fact that some process had been employed not easily understood. Prof. Hanks finally obtained the address of a gentleman represented to him as being of unquestioned character, Richard Hurley, residing in the vicinity of the wonderful springs in Wasco county, and applied to him for information. In reply to Prof. Hanks, Mr. Hurley writes: "There is no mistake as to this mud containing silver. I have assayed over 100 samples which contain silver, some as high as $2,300 to the ton. The samples I obtained from the springs myself. I think the weather has considerable to do with the mud containing silver. I obtain the best results when the weather is warm. Sometimes in one of the larger springs, when the weather is cold, the mud will be of a yellow color, showing no silver, but when the day is warm the mud is blackish blue, at least in places, and rich in silver. They seem to work more actively in a warm afternoon. Some of them contain a great deal of acid, the bones of animals that fall into them being dissolved in a few months. There are old wells which assay from $5 to $1,200 to the ton. One assay I made from the flat, half a mile from any spring, assayed $1,200 to the ton. There is a great deal of salt, almost pure, all over the spring flat. There are between 100 and 200 quartz leads discovered, running in two directions, close to the spring. I find silver in several of them, all the way from a few dollars to $100 to the ton. Some of these leads run through the springs, at least they point in that direction. The altitude of this place is between 4,000 and 5,000 feet."

Prof. Hanks also refers in his paper to the recent discovery of a peculiar silver-bearing deposit located in Southwestern Utah. It occurs in the "Maud Mine," six miles from Leeds. Some assays as high as $700 per ton have been made. Instead of being sandstone, as supposed, Prof. Hanks found the deposit to be sedimentary, but closely resembling the Oregon mud. Under the microscope it has all the appearance of that strange substance. The Oregon mud, if allowed to dry in large quantities, would soon form a similar substance to the Utah mineral, in appearance at least. The silver is in the state of chloride, and is seen under the microscope both amorphous and in crystals. An analysis of the two minerals will be interesting, and may throw some new light on the subject. It is possible that a study of these deposits may contribute much to our knowledge of the formation of metalliferous veins.

THE MINERAL WATERS AND BATHS OF CHILE.

The *Edinburgh Medical Journal* has an article by Dr. John Boyd on the "Medical Society of Chile," in the course of which the following account is given of the medical springs of the country:

Mineral Waters.—Chile possesses a great number of mineral and thermal waters, but only a small proportion of these has been utilized for the benefit of the sick. Almost all of them are found at the foot of the Andes, or on its declivity; the most celebrated and most frequent being the following:

1. *The Baths of Chillan*, situated at 1,864 meters above the sea-level, in a volcanic region, little distant from the perpetual snows. Of its various affluents, the most important is the sulphurous, the temperature of which reaches 58° (136.4° Fahr.). From their high elevation, these are only accessible during the summer months, and the accommodation for patients is middling. In other respects, the access is sufficiently easy.

2. *The Baths of Cauquênes*, on the banks of the river Cachapol, and at 677 metres above the level of the sea. They are alkaline waters, varying in their temperatures in the various springs from 35° to 47° (95° to 116.6° Fahr.). The establishment can vie in every respect with the most celebrated in Europe.

3. *The Baths of Apoquindo*, a few leagues to the east of Santiago, at a height of 799 metres. They are equally alkaline, although less concentra-

ted, and the different streams have a temperature from 17° to 28° (62.6° to 82.4° Fahr.). At these baths may also be found every accommodation for the infirm and other visitors.

Equal convenience may be found at the baths of *Colina*, situated at ten leagues to the northeast of Santiago, at an elevation of 909 metres. The temperature of the waters is from 25° to 32° (77° to 89.6° Fahr.). This contains a quantity of alkaline principles in solution; they are nevertheless very efficacious in certain maladies.

In all the other baths, which, from their chemical composition, might be even preferable, there has not been the slightest trouble taken to gain access to them easily, or to supply the means of lodging or living there with any comfort. It is necessary to bring all sorts of provisions, beds, etc., with one, to erect a hut or cabin, and to bath in the open air. Hence it arises that, with few exceptions, only the inhabitants in the vicinity of these baths make any use of them or have any experience of their medical virtues.

METEOROLOGY.

THE STORMS OF JUNE AND JULY, 1877.

(COMPILED BY THE EDITOR.)

Within the past six week unusually severe wind storms have prevailed in different portions of the country under circumstances so different and exhibiting such peculiar phenomena that it seems impossible to reduce them to any system or classify them under any law hitherto suggested by either Redfield, Peddington, Reid, Espy, Peslin, Faye, or Tice.

Without attempting to establish or support any theory regarding such phenomenal occurrences, we will briefly quote from that of the distinguished physicist, Faye, of Paris, which differs materially in many respects from those of the earlier writers:

"*First*, cyclones, hurricanes, typhoons, tornadoes, and waterspouts are phenomena of one and tne same mechanical nature, and to all of which the same general explanatory theory will apply. *Second*, since the eye can embrace the two latter phenomena in their totality, while the other three classes of storms are spread over too vast an extent of territory for any one observer to seize all their features directly, therefore we ought at first to begin our discussion and investigation with the consideration of tornadoes and waterspouts, at least if we desire to base our conclusions upon facts only. *Third*, the greater part of meteorologists attribute these phenomena to a vertical aspiration, whose existence they gratuitously assume at the commencement of their investigation. Under certain statical conditions of the atmosphere this aspiration can, according to them, develop mechanical effects of astonishing power. According to them the gyration which is so characteristic of these storms is only an incidental matter, resulting simply from the reaction of the ground upon the horizontal currents, that ground being animated by its slow daily rotation. This reaction, which changes by only 40° the direction of the lower trade-winds in their long course, is made to describe many circumferences in the space of a few yards and in the interval of a few seconds, in the course of these pretended horizontal currents, whose existence not a single observer has as yet noticed. According to the theorists, these latter converge violently from all sides toward the lower orifice of the waterspout or the tornado, in order then to spring vertically through this narrow orifice up to the region of the clouds under the form of a column, surrounded by vapors condensed by cooling, and spreading as they ascend. *Fourth*, on the contrary, I submit that the common origin of all these phenomena is found in the upper currents, whose power and directions are clearly shown to our eyes by the clouds, and not in the lower strata, where an almost perfect calm continually reigns. Not, of course, that a calm reigns at the precise spot where the waterspout exists at any moment, but all about it. Upon this capital point, so easy to demonstrate, so frequently denied by observers, and which lends so much to the solution, all the witnesses are agreed. This does not prevent the aspiration theorists from placing violent currents, like immovable layers, around the heart of this perfect calm, which the waterspout or the tornado does not disturb for an instant in its rapid course. Never have we seen in science a similar disregard of facts; a strange indifference which is explained only by the influence of a very ancient and very extended prejudice, whose history I have traced in the *Annuaire* for 1875, and which has caused meteorologists to replace facts by theories upon the stability or instability of atmospheric equilibrium."

We will now mention several of the more notable storms of the month of June or July, and as far as practicable point out their striking peculiarities.

One of the most severe, though exceptionally local in its character, was that of June 4th, which visited and nearly destroyed the town of Mount Carmel, Illinois. Mount Carmel is located on a plateau at an elevation of about 75 or 80 feet above the Wabash river, and about three-fourths of a mile west of that stream.

Prof. J. H. Tice, of St. Louis, visited this place about two weeks after the passage of the tornado, and we avail ourselves of the information obtained by him from eye witnesses:

"The streets run parallel to the river or rather to the bluff on the east side of the town; hence do not conform to the meridian and parallels of latitude. Main and its parallel streets run from about fifteen degrees west of north toward the same numbers of degrees east of south. Consequently the cross streets, Fourth, for instance, at right angles to Main street, run from fifteen degrees south of west to the same number of degrees north of east. The bluff, southeast of the town, turns a right angle to the westward, hence all streets terminate at right angles on the bluff. The tornado came nearly from the southwest or about on a direct line with Fourth street, which it followed centrally from end to end, throwing out spurs occasionally that demolished buildings and did considerable damage on adjacent parallel streets. It has been ascertained that the incipient formation of the tornado took place in White county some eight miles north of Carmi and some thirty miles distant from Mount Carmel. It there demolished a house and wrought some other mischief. It made long leaps and dipped down several times before it reached Mt. Carmel, but it probably would have passed without doing much if any damage if it had not been reinforced by a heavy column from the eastward. This column, in the form of a funnel, was seen by Mrs. Turner, who lives on the street fronting the bluff south. She is a lady of more than ordinary intelligence, and well posted in meteorological matters, having a son in the Signal Service stationed at Bristol Bay, Alaska. This cloud she told me was dark green:—very ominous, since this color indicates hail, and its funnel form a tornado. This cloud moved westward behind the shade trees that line and adorn Front street on the brow of the bluff, where she lost sight of it. But she said it sent off a well defined tornado that swept up the bottom between the bluff and the railroad bridge that spans the Wabash here; and pointing out the trunk of a large prostrate sycamore, she said: "It threw that down before I heard the roaring of the tornado in the southwest." Mr. Charles Ridgeway, station agent at the depot, saw this cloud coming from the east, meeting a similar cloud from the west, and immediately a spout shot down with fearful velocity toward the earth. Judge T. J. Shannon's residence is west of the depot and about a quarter of a mile north of the railroad on high land.

Mrs. Shannon's statement, furnished to me in writing, is this: "I was standing at my sitting-room window watching the approaching storm, when I saw two heavy clouds meet; and instantly heard a loud roaring. I thought a long train of cars were coming at full speed. I soon discovered it proceeded from the cloud now looking very singular and whirling at a rapid rate with shingles, planks and timber flying around in it. It appeared not more than fifty feet in diameter at the bottom,* widening towards the top. I do not think it could have been more than 75 to 100 feet in height, and in form nearly funnel shape. Its forward motion was from west to east, and seemed to follow a straight line as though a track for it to pursue had been marked out for it from the woods near where it first struck towards the town. It whirled towards the north.† It snatched up

*1. The area swept by it, however, averaged three hundred feet wide. Mrs. Shannon's point of observation was fully three quarters of a mile distant. This accounts for its apparent diminutive size. This also was at the time it struck the first house, fully a mile and a half from town.

†2. This statement being indefinite, I called her attention to it, and asked what she

every thing in its path. When it struck the main point in town I discovered that it moved up and down and tossed about some.* The cyclone was shaded alternately in light and dark streaks, looking very much like smoke and steam thrown from an immense engine."

The next person that saw it from the north side was Mrs. Jacques. Her residence is three squares north and two squares east of Fourth street, the street ravaged by the tornado. Her view was obstructed some by the dense row of shade trees on the south side of the street. She says the clouds were intensely black, shaded with streaks almost snow white; that the shape of the cloud was that of an immense funnel, through which things were ejected upward in a whirling motion contrary to the hands of a watch, consisting of roofs, houses, timbers, shingles, boards, and everything gathered in its course, while the things thrown out at the top were in many cases drawn in again below. This is in accordance with Mr. Wise's balloon experience. Seven times was he drawn into and thrown up through the vortex of a hail storm, then thrown out at the top, and while descending drawn in and thrown up again. I and others have observed this action in vapor during a tornado, but this is the first time as far as I know that solid matter has been observed to behave so. That such was the case in this instance, is evident from the fact that the three little school girls who were snatched up near the school house on Fourth street, saw the Methodist church steeple away below them. After being carried 1,100 or 1,200 feet they were for an instant deposited in a mud pond, then snatched up again and carried 600 feet further, where they were left unharmed, except soiled clothes and badly frightened. I could not find any one on the south side of the storm's track who saw it; probably because the ground was not very favorable for observation, the view being obstructed by the dense foliage of the beautiful sugar maples that line the sidewalks of the charming city.

Mr. Valentine Smith, who saw it in front and approaching until it was within a hundred feet of him, and whose house was partly demolished, in substance gave me the following statement:

His place of business is on Fourth street near where the court house stood, five or six doors north and on the east side of Main street, nearly op-

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meant. She stated that she meant that things whirled on it, moved from west by way of north thence east. I informed her that this was impossible, that this would be the cyclonic whirl of the Southern Hemisphere, and that in the Northern Hemisphere the whirl is invariably from east to north, thence west, etc. She however insisted that it was as she stated it. But she is laboring under an optical illusion; the scattered debris of houses destroyed in its path unmistakably shows the whirl to have been from east to north thence west, or normal for the Northern Hemisphere. The prostrate trees on the Indiana shore, near White River, establish this point beyond question. I invarably found the first trees prostrated, that is those at the bottom, fallen either from the south or east. Upon these lay in succession those fallen from the northeast, then those from the north, ending with those from the west on top.

*3. The *ricochet*, however, is evidently from the beginning. After destroying the first house it leaped a barn directly in its path, and completely wrenched off the top of an elm tree not fifty feet beyond the barn. There is evidence that it hugged the ground continuously, or nearly so, from the time it leaped the Airline Railroad and struck east of it, to Main street or perhaps the Methodist Church. Then there was an independent stroke to the right and soon after a terrific one on the main line again.

posite to where Messrs. Biddle & Keneipp's large brick store was demolished. He said: "Finding a storm was approaching I ran up stairs to close the windows. Hearing a terrible roar and continuous explosions like rapid musketry firing during the war, I looked out and saw the tornado coming up Fourth street. It was very black with white streaks like steam in it but the heart of it was fiery red like a flame. I thought Mr. Biddle's house was on fire, and that the tornado was sucking up the flame. An instant more and it was as though a huge wave had struck a ship and the wall of the house flew out as is it had been shot away by a cannon." Mr. Sebastian Seller, whose dwelling on Fourth, east of Main and beyond the Methodist Church was utterly demolished and his garden desolated and ruined, makes the following statement, so I was informed by credible persons. I was unable to see him myself for want of time, the information reaching me too late. His description of the cyclone accords with that of all others, with this addition: "It looked like the burning of dried leaves in a green brush heap; there were bright dancing flames all through it." Since these witnesses were nearer than any others to it, and since they had an unobstructed view of it, it is not at all surprising that they saw more than any one else saw.

The fire or flame they saw in it is not unusual. It is found graphically described in the first chapter of Ezekiel, in the whirlwind described by the prophet. Mr. Tooley who described the tornado that occurred at Natchez May 7, 1840, by which 317 persons were killed, says it was of a lurid yellow. Chappelsmith who described the tornado that occurred at New Harmony, Ind., on April 30, 1852, says, "the cloud appeared on fire at the bottom, like a large pile of burning brush; others say it was a cloud with green and red flame, and others with green and blue flame. Mrs. Bissell, and others, who saw the lowest point of the cloud spout that caused the tornado in St. Louis county on the 29th of July last, say it was tipped with a fiery mass as large as a barrel bowling along like a huge ball.

Sergeant Henry Calver, whom I had the pleasure of meeting at Mt. Carmel, who investigated the tornado of Georgia and South Carolina that occurred on the 20th of March, 1875, in his report to the Chief of the Signal Service, says: "Dr. Charles Biddle states that it presented all the colors of the rainbow, sometimes with considerable yellow, and again with the appearance of fire." Several other persons corroborated Dr. Biddle's statement, as to colors and fiery appearance. The accompanying noise was a heavy roar, and as it approached nearer a crackling noise was distinctly audible. Mr. Calver adds, "the last mentioned sound may have been caused by electric discharges, as it would hardly be possible to distinguish the noise made by the breaking of trees, etc., at the distance of two miles or more." This fiery appearance of the cloud in the same report is stated many times and by witnesses at far distant localities, but I have not time for more quotations

Many of the trees, and nearly all of those on the Wabash bottom, are seared as though a flame had passed through them. I was informed that the leaves had this appearance immediately after the storm. Tooley says of the Natchez storm, "the effects of the storm upon the leaves and buds of plants was to sear them so that they crisped. Some very thrifty grapevines were entirely killed—even the succulent *morus multicaulis* appeared as if an Eastern sirocco had passed over it." The same phenomenon has been often observed in different localities as attending tornadoes. A sufficient cause must exist that produces it. * * * * * *

Upon the hypothesis that it is electricity, we encounter no difficulty in the way whatever, provided we are familiar with electric laws, and versed in the principles of electric science. * * * *

Two great principles are only necessary to be mentioned here: 1—That any insulated matter when charged, will by induction evoke an equally potent charge of the opposite electricity upon the nearest point of adjacent matter, instant communication between these two opposite points taking place, so that these charges mutually obliterate each other. The earth always is negative and the clouds positive. Hence a cloud in proportion to the intensity of its positive charge evokes from the earth beneath it an equally intense negative charge, even though the latter were devoid of negative electricity. Hence communication between the earth and the cloud is instantly established in order to obliterate the charge on the cloud. The tornado is the effect of the act of communication, thus established. 2—The other principle is that electricity cannot pass between two points except by one of two ways, (1) by conduction where the two points are connected by continuous matter; and (2) by convection, where the points are insulated or where the matter is discontinuous. Those who have any doubt about this may consult the works of the late Professor Magnus of Berlin, or those of Professor Schelen of Cologne, the world-renowned spectroscopist. The latter says: "The electric current requires a material conveyor for its transmission from one point to another. It cannot pass where there is no trace of either gas or vapor." He might have stated that where there is neither a trace of gas or vapor in contact with, or free matter upon the discharging pole to give electricity convection, it improvises a conveyance by disrupting matter from the pole, whether that pole be of metal or any other substance and throws it across the intervening space upon the other receiving pole.

The hurling of matter into, and up through the vortex of the tornado is hence only a discharge of electrified matter conveying electricity from the earth to the clouds; the gravity as it is called of the matter affected being overcome by the attraction of the cloud above which gives it a pull in front, and the repulsion of the earth below which gives it a shove in the rear. This action can be simulated in the laboratory. Paste a piece of paper upon any good conducting substance and pass a charged conductor rapidly above it; as the conductor passes by, the more rapidly the better, the paper instantly leaps upon it. This principle explains the whole mystery of electric action in the tornado.

The reader must now be qualified to comprehend the singular action of a tornado. This one like all similar tornadoes passed through a calm air. At the railroad depot during its passage the air was perfectly calm and still, followed a few moments after by a sudden strong wind from the opposite quarter. Its passage was too rapid for the surrounding air to be put in motion. Had time been given for the air to rush in, no houses, trees nor other matter would have thrown themselves into the vortex. In other words no effects would have manifested themselves otherwise than a strong whirlwind. Persons in the track of the cyclone were astonished to find such instant and terrible effects occur with so little wind in the front of the storm. Trees showing scarcely any agitation were seized as by a herculean hand and instantly jerked into the approaching storm center. The bell on the court house was instantly thrown 100 feet across Main street directly in the teeth of the storm. A frame house near where the bell fell leaped five feet back from the street and also in the face of the storm. Roofs and the west walls of houses jumped into the approaching vortex. On its south flank the south walls did the same. East walls and roofs and sections of roofs, threw themselves into the retreating vortex. West of town there stands a pecan tree about 20 inches in diameter; from appearances it stood very near if not quite in the center of the vortex. The bark, except two small strips, one of which, however, is completely detached from the trunk —shot into the passing vortex. The evidence of electric action here is unmistakable. The way that the bark was wrenched off shows that the force came from the tree as a center. On the west side, the tree split into a thin slat not one fourth of an inch thick. A section of this slat, about three quarters of an inch long, is cut out as though a bullet came from the center of the tree. Mr. Landers, who accompanied me, probed the depth of the orifice. A small twig could be run in without difficulty to a depth of 2½ inches. The tree stood in a grassy plot. All around the tree the sod was thrown out three inches in depth, exposing the roots, showing an electric charge coming from the roots. Philip Stein's blocks on which his stable stood that went up in the vortex, show the same fact. The blocks were buried to within an inch of the top. The soil is also shot away around them to a depth of three inches. They were double blocks about 14 inches in depth. At one corner both blocks were shot out; the upper one I left on the ground, but the lower one went no one knows whither, because it has not been found.

Into the overhanging vortex, houses, roofs and everything free on the earth below leaped perpendicularly. Mr. Lewis Gott, who was a square north from where his new and unpainted house stood, and in which he lived, hearing the roaring sound in the direction of the new house, saw it go up bodily and plunge into the cloud; that is the last seen or heard of it, for not a fragment of it nor of anything that it contained has yet been found. Mr. Solomon Kenepp saw the store building, a strongly built brick, two stories high, and 43 by 20 feet, lifted up from the floor so that he could see out under it on two sides. Then suddenly everything came crashing down burying him, his partner, Mr. Moses H. Biddle, and others.

The steeple of the Methodist Church on Fourth, east of Main, was torn off and broken in two. The lower half was ripped asunder and thrown in opposite directions. The upper half was carried upward and no vestige of it has been found.

A sack of flour from a demolished store on Main street was carried five miles beyond the Wabash into Indiana, Except a small slit—cut perhaps by some flying missile—it was uninjured. Debris has been found for fifteen to twenty-five miles in the track of the storm in Indiana. Letters have been found fifteen miles north of Vincennes, or forty miles from Mt. Carmel.

I saw several houses, Mr. Steitz' amongst the number, that were lifted and twirled, and then set down. The most curious fact observed at Mr. Steitz' was that a portion of the brick wall, two bricks in depth and about ten feet long, adhered to the sill of the house, a frame, and was carried with it in its twirl. The house has since been shoved back, but the aforesaid portion of the brick wall marks the line where the house had been set down.

Many evidences also exist here of the hurling phenomena of tornadoes. In Mr. Joseph Harris' house, a block or so east of Main, on the north side of Fourth, a brick was hurled at an angle of not more than ten degrees with the horizon through the wall of the house, passing across two rooms, and breaking through the studding and plastering of the rear wall, without breaking the brick. A small fragment of a brick came through a window and cut the carpet as if done with a knife. At Philip Stein's I saw two rafters hurled forty-eight inches into the soil. One broke off about three inches above the surface of the earth and was hurled against a pannel of paling fence, which it knocked down."

On June 23d a violent tornado struck St. Joseph, Mo., coming from the southwest and destroying and damaging a large number of buildings. The same storm also did considerable damage at Leavenworth City, Kan.

On June 25th a very heavy wind storm, originating probably in Colorado and extending over a width of not less than three hundred miles, passed over this city at about half after six in the morning, and resulted in a general hurricane as it proceeded eastwardly with increasing velocity as far as central Ohio. Reports from points all over Missouri, Iowa, Illinois and Ohio, together with some from Southern Wisconsin and Kentucky, show it to have been extremely violent and destructive. Buildings of all kinds were demolished, and at different points railroad trains were blown from their tracks and many lives lost. It was accompanied with rain in many places and by hail in others. It was probably more general in its character than any that has occurred for several years. At the time of its passing this city it was not regarded as more than a brisk gale, but between here and Chicago it reached an average velocity of nearly 50 miles per hour, between here and Cincinnati a velocity of 52 miles per hour, and between here and Columbus, O., an average of 57 miles per hour.

On Saturday evening June 30, a severe tornado, originating in the State of Illinois a few miles east of St. Louis, Mo., struck the town of O'Fallon and nearly destroyed it. Its approach and unusual action are thus described by an eye witness:

"Light colored, but heavy clouds, had at intervals during the day obscured the sun. In the afternoon, dark cloud banks rolled up from the northwest. The atmosphere became sultry and oppressive, and was heavily charged with electricity. The dimness of twilight fell over the landscape. Fitful flashes of lightning in the west were accompanied by low rumbling thunder. The storm at last took position, heaven's artillery was wheeled into line, as it were, a flash of lightning of great brilliancy was seen, and the forked tongue of the shaft launched downward. A monster oak in a grove one mile west of the little town was riven by the stroke. A deafening clap of thunder followed. The flood-gates were opened, and the rain poured down in a deluge, while the lightning flashed and the thunder rolled with a frequency that was almost horrifying. The tempest abated. The streets were filled with water. Some few people ventured out. The tempest had passed almost due east from west. Those who looked out after this lull saw that it was raining off towards the northwest. A loud noise was heard, like unto the rumbling of a train of cars crossing a covered bridge. The rain in the northwest advanced in a southwesterly direction toward the town. Heavy clouds, which, from time to time emitted sullen electric flashes, scudded before the wind from east to west.

The clouds from the northwest continued on their course, the angry roar growing louder as the storm approached. It struck the path of the tempest. There was a strange commotion. The clouds were seen to bubble and boil violently, the appearance being that of vapors struggling to liberate themselves. In an instant a cone-like form was assumed, and as if directed by some revengeful spirit omnipotent in the air, the cyclone darted toward the earth, striking the ground at a point a half mile due west of the town. A small frame building, owned by A. C. Jones, was seized in the grasp of the destroyer, and the fragments went flying through the air. Unlike the Mount Carmel cyclone, this one did not follow any especial route, nor did it make a clean sweep before it. It bounded from right to left into the air and back again like some wounded thing. Whatever it touched it destroyed. It would make a bound and a swoop, and some substantial building would fall in ruins, while some fragile structure a few yards away would remain unharmed. Stables were overturned, while residences within twenty feet would be passed unscathed. At times the thing, seemingly not satisfied with its work, would go back upon its track and destroy something left in safety before. It passed on through the town, and was next heard of two miles east, where the roof of the home of the Widow Westfield was taken into the air and carried hundreds of yards. It then made a detour to the southeast for the purpose of wrecking the house and barn on the old Thomas place, finding time in the same connection to severely, and probably fatally, injure Krost Thomas, a youth of eighteen. Making a leap to a barn a half mile due east of the Thomas place, which it succeeded in unroofing, it made a bee line for Lebanon, just six miles east of O'Fallon, uprooting trees and ruining wheat and corn-fields *en route*, where the spire of the Methodist Church succumbed, as did several small shanty structures. At Lebanon the presence of the tornado was marked by one of the severest hail storms ever experienced in that locality. The storm continued on its eastward course, making a number of devastating calls." This same storm seems to have passed onwards in a northwesterly direction, skipping over the State of Illinois and crossing the States of Indiana and Ohio into Pennsylvania, and doing great damage at Mooresville, Brooklyn, Columbus, and St. Paul, Indiana; Springfield, Mount Vernon and Zanesville, Ohio; Parkersburg, Ercildoun and Coatesville, Pa. It is described as being from half a mile to two miles in width, and in most places was accompanied with a very heavy fall of rain.

On the morning of July 1st, between eight and nine o'clock, a storm, which is described as the "most destructive ever witnessed in Eastern Indiana," devastated the section of country between Middleboro, Indiana, and New Paris, Ohio. It is stated as a remarkable feature of this case, that "two wind clouds, one above the other, rolling in northwesterly and southwesterly directions, produced a whirlwind."

On July 7th a terrible whirlwind struck the town of Pensaukee, Wisconsin, twenty-five miles north of Green Bay, on the Chicago and Northwestern R. R., leaving but three houses standing. The storm came from the northwest, and passed on southeasterly, destroying the town of Coullardville in its course. Its track was less than eighty rods wide, and its force was expended in two minutes.

On July 9th a heavy storm of wind and rain passed over northern New York and Canada, destroying many buildings as well as crops and fences.

Numerous other local storms have been reported, both North and South, but the most important ones have been given above.

The storm theories of Prof. Tice are sustained to some extent by the observations of Father Secchi, who, in writing to a friend in Belgium, alludes in striking terms to the remarkable connection between the magnetism of the earth and the changes of the weather. He says that the variations shown by the magnetic instruments are themselves sufficient to indicate the state of the sky. Even where there is no great movement of the barometer, following such magnetic disturbances, there are, especially in summer, changes of the wind and sometimes storms.

In this connection we copy from the Kansas City *Journal of Commerce*, of July 15th, a condensed statement of a new theory in relation to tornadoes:

"The Signal service has given us a new fact in relation to tornadoes which has given rise to a theory that may lead to another link in the chain of investigation respecting the law of these terrible visitants.

"Its nomenclature is borrowed from the railway, and termed the thermal gradient. Take for example the late tornado at Pensaukee, Wisconsin. At the time of its occurrence a steep thermal gradient prevailed between the Mississippi and Lake Michigan—in length about one hundred and fifty miles. At La Crosse the thermometer stood at 95° and at the Pensaukee end it was 65°, a difference of 30°. This condition, it is claimed, with the difference in the atmospheric density and humidity, furnishes the conditions necessary to develop the tornado.

"The character of the movement is a violent rupture of the superincumbent strata of dense cold air by the highly heated surface stratum. In the effort of the latter to expand and obtain an outlet it acts like steam when confined in a boiler. If this is correct, the greater the difference in temperature between the points on this thermal gradient, the more violent will be the atmospheric explosion.

"The gradient in the case of the Pensaukee tornado, was a descent in the temperature of 1° for every five miles. A tornado then under this theory was inevitable. Whether the theory is a correct one, is open to discussion, but the fact is not, and therefore valuable, because it is from the accumulation of facts that the law will ultimately be established."

THE PERUVIAN TIDAL WAVE.

(COMPILED BY THE EDITOR.)

On the 10th of May, 1877, a great tidal wave brought destruction to many thriving towns along the coast of South America, and especially along that of Peru. The appearance and effect of this wave is well and fully described in the extracts given below from various local papers, but there seems to be some disagreement among observers and theorists with regard to the origin or starting point of the wave itself. The journalists of San Francisco seem to attribute it to an earthquake occurring on the evening of the 9th of May, resulting from an eruption of the volcano Ilaga, situated on the southern borders of Peru and Bolivia, while a writer in the *Christian Union*, from the Hawaiian Islands, connects it directly with an eruption within the crater Kilauea, and a subterranean upheaving of the water in Kealakeakua Bay. On both coasts at about the same time violent shocks of earthquake were felt, great disturbances of the ocean were observed, and immediately following came immense waves, varying at points along the South American coast and that of Hawaii from five to sixty-five feet in height, which swept away or seriously damaged many towns and destroyed thousands of lives.

One of the most remarkable circumstances connected with these phenomena is the rapidity with which such shocks are borne by the waves across immense stretches of oceanic space. One thousand miles an hour is not regarded as an unusual rate of speed, and, as will be seen below, the transmission of the tidal wave under consideration approximated this rate between the Sandwich Islands and San Francisco.

The vast distances that such waves are projected are quite as remarkable as their rapidity of motion. From a central point on the Peruvian coast, say Iquique, to Hilo on the Hawaiian coast cannot be less than 5,000 miles, probably more, and the wave seems to have traversed this distance within the space of ten hours from the date of the earthquake. At the time of the destruction of Lisbon, in 1755, the marine wave resulting from the shock was carried to a distance of nearly 4,000 miles, striking the shores of America before stopping.

In 1854, at the time of the earthquake of Simoda, Japan, the wave that reached the coast of California had traversed the entire width of the Pacific Ocean.

The following descriptions of this wonderful but disastrous phenomenon have been compiled from various local papers, and probably give reliable details. *Harper's Weekly* gives the following condensed statement:

"From the Peruvian coast there comes a thrilling tale of disaster and ruin. The severe earthquake that occurred on the night of May 9th, and the tidal wave that followed, breught destruction to many thriving towns along the coast of South America, and death to hundreds of their inhabitants. The earthquake seemed to result from the eruption of the volcano Ilaga, situated on the southern frontier of Peru and Bolivia. The first shock lasted from four to five minutes, and was succeeded by several others of less intensity. Then the sea, receding from the shore, seemed to concentrate its force for repeated attacks upon the land. At Arica the people were busily engaged in preparing temporary fortifications to repel a threatened assault of the rebel ram Huascar at the very moment when the roar of the earthquake was heard. The sea suddenly receded from the beach, and a wave from ten to fifteen feet in height rolled in upon the shore, carrying everything before it. Eight times this assault of the ocean was repeated. Strange as it may seem, only a few lives were lost at this place. At Iquique the wooden houses came tumbling down at the first shock, and a fire immediately spread among the ruins. The firemen, to procure water, had just stationed two engines on the beach, when a fearful cry arose—"The sea! the sea!" and the angry waves rushed in, and the engines were carried away. The inhabitants left the city to its fate, and fled to neighboring eminences. The earthquake, the fire, and the water, all combined, destroyed nearly the whole town, and also about 400,000 quintals of nitre stored in the vicinity. It is supposed that at least two hundred persons were killed at Chanavaya, where the shock was especially severe. Mexillones (or Mejillones) was visited by a tidal wave sixty-five feet high, and two-thirds of the town completely obliterated. A mine about four miles from Tocopila sank in, killing about two hundred workmen. A wave thirty-five feet high swept along the principal business street of Cobija, an important town on the Bolivian coast, and left it as level as a desert. Eleven large vessels were totally lost, with many persons on board, and much other shipping seriously damaged. The property lost is estimated at twenty millions of dollars, and the loss of life on shore is supposed to be not less than six hundred."

The *South Pacific Times*, of Callao, Peru, says, to call the movement of the sea, which resulted in such a terrible loss of life, a tidal wave, is a misnomer, as a wave implies an undulatory motion, while the action of the sea in this instance was a series of distinct rotary upheavals, breaking into many cyclonic currents of great speed and power, and continuing for many hours. Later accounts from Valparaiso indicate that that port did not suffer much from the cataclysm, but the other Chilian ports did not escape damage, although not serious in comparison with that suffered in other places. Peru and Bolivia are the two countries that suffered most, the latter probably more than the former.

The movement of the sea is described as being very similar in all the ports along the coast from Callao to Coquimbo, Chili, although varying greatly in intensity. Pabellon de Pica is regarded as the center of the disturbance. At Callao the sea showed unusual agitation as early as 11 o'clock on the night of the 9th of May, and shortly after the bay was filled with gyratory currents, causing the ships at anchor to revolve about their chains as centers. The actions of the currents were strong enough to break away the stern moorings of large steamers. The sea showed several distinct upheavals, the highest one occurring about 4 a. m. on the 10th of May, the stone docks at that time being submerged. There were no disastrous results to the shipping in Callao harbor, but at the guano deposits considerable damage was done, and at one time the whole fleet was in danger of being cast ashore. The Governor of the guano deposit at Pabellon de Pica reported to the Peruvian Government that a powerful earthquake, extending all along the coast, commencing about 8:15 p. m. on the 9th of May, and lasting five or six minutes, caused the instantaneous outbreak of fire throughout the town, a fire which was in turn extinguished by the sea, which invaded the settlement six times, and shifting the position of the Government buildings, destroyed molls, boats, hydraulic machines and all the works connected with the loading of guano, and more or less damaged all the vessels at the deposit by collision or otherwise, sinking six. The loss of life at Pabellon was not fully ascertained, but 33 laborers are known to have been buried by a landslide. The Governor also states that there are 1,000 people without food and in danger of stavation.

At the nitrate deposits the works were thrown down by the earthquake, and those of Nueva Carolina, San Pedro, Matellana and La Barrencaber were ruined, involving a loss of 1,400,000 soles. Those at San Juan and Compania Taropoca were badly damaged. The entire loss at the nitrate deposit, including supplies, can be set down at not less than 3,000,000 soles, more than double the loss experienced by the earthquake of 1868. The damage in the port of Constitucion, 120 miles to the southward of Valparaiso, was quite severe, several vessels being stranded and some of them totally destroyed. Ashore, the alarm was great, all the inhabitants flying to the hills, but up to the latest accounts there was no loss of life. Valparaiso seemed to enjoy a total exemption from loss. In Arequipa nothing more than a terrible fright was suffered. In Chanaral, Chili, about half past 8 P. M., on the 9th of May, a strong shock was felt, lasting for about three minutes. In the confusion a paraffine lamp upset in a house, and in a moment the edifice was in a blaze and the fire rapidly spread. While the greater part of the population was engaged trying to repress the conflagration, the sea was observed coming in, and it completed the destruction. The loss of life is confined to two persons, and two thieves were shot while detected in plundering. The damage to property will exceed $200,000. In Antofogasea forty or fifty houses were completely destroyed, seventeen launches thrown on the beach and three sunk with cargo. Mejillones is represented as totally destroyed, as were Cobija and Tocopilla. The store ship of the P. S. N. Co, has disappeared entirely, the family of the master of the hulk being on board at the time. In the vicinity of Chanavaya the loss of life was very heavy, nearly sixty men being killed by falling rocks that came down from the heights. The town of Chanavaya has completely disappeared, and large numbers were drowned, especially women and children. At Punta de Lobos considerable damage was done to the shipping, and nearly all of the buildings were destroyed. The unsheltered inhabitants are suffering untold miseries, and at the latest advices were on the verge of starvation. At Carrizoe Bajo, in Chili, the shock was very severe, and the steamer Luis Cousins was driven ashore many times, her hull suffering severely. At Pisco the damage to property and shipping was heavy, but no loss of life was experienced, although the houses in the town were nearly all destroyed. The *Times* gives a list of vessels totally destroyed, aggregating over fifty, and details of serious injuries to about seventy-five more. In addition to the disaster in Bolivia already reported by telegraph, all the people in one of the mines in Pera Blanca are known to have been smothered. The damage to Pabellon de Pica by the latest advices is summarized as follows: Over two hundred lives lost, five vessels sunk, twenty-seven so badly damaged as to be unable to leave the port. As nearly as can be ascertained the total loss of life in the visited district will aggregate fully 1,500, and the loss of property is enormous.

The San Francisco *Bulletin* says: "The more detailed statement of the late earthquake in Peru received from New York, gives the date of the occurrence as the 9th, but the compiler provokingly omitted the hour of the day. The first report of the convulsion, received by the roundabout way of London, gave the date as the 10th. But a calculation of the time at which the tidal wave which followed the earthquake manifested itself at other points shows that this could not have been correct. The chances are that the telegraphic agent at London failed to notice that there were about four hours' time against him between Peru and his station. What was to him the 10th of May was the latter part of the 9th at the scene of the disturbance. Unfortunately, in no case is the exact period of time given at which the tidal wave appeared anywhere, so that no precise calculation can be made. But approximations are possible, which indicate that we may be on the eve of important scientific discoveries.

"Taking our date at 7:10 A. M. as a basis, we reach the following facts: The Sandwich Islands being 2,100 miles further westward are 2:20 ahead of us in time. At 4 A. M. the tidal wave manifested itself at Hilo. That would represent 6:30 A. M. at Anaheim. The time of the transmission of the wave to this coast would seem, therefore, to have been fifty minutes. Now, the time reported at Acapulco is 10 A. M. But Acapulco is about 1,500 miles more easterly than the coast of California. The difference in time will therefore be one hour and forty minutes—that is to say, Acapulco is, by that much, behind us. Four A. M. at Hilo would represent 8 A. M. at Acapulco, apparently allowing two hours for the transmission of the tidal wave between these points.

"The great fact here to be noted is that the tidal wave rolled upon the beach at Hilo fifty minutes before it was felt on the coast of California, and two hours before it inundated Acapulco. The height to which it attained at these points would seem to strengthen this view, for it was in greatest force at the place where it rose the highest. Waves lose force as they progress. Thus the tidal wave was twelve feet three inches high at Hilo, five feet at Anaheim, and three feet at Acapulco. But at the point of the original disturbance it was sixty-five feet high. This estimate is not extravagant when it is considered what it did, viz: it destroyed many towns, and lifted the United States steamer Wateree, stranded by the tidal wave of 1868, and carried her nearly two miles north of her old position.

"If we had the time of the tidal wave on the coast of Peru the calculation could be completed. But so far its dimensions are reported as follows: 65 feet at Mexillones, 12 feet 3 inches at the Sandwich Islands, 5 feet on the coast of California, 3 feet at Acapulco. Nothing has been heard of it south of Peru, but it is supposed to have been felt along the coast of Chili. It was noticed about the same time as the earthquake, or immediately thereafter. The first fact was a slight recession of the water, and then a return on the land with prodigious force, reaching the altitude stated. Then it flowed off, the power which it evoked propagating itself, apparently, northwesterly, to the Sandwich Islands, but retaining enough of force to rise 12 feet 3 inches there, then washing over on the coast of California 5 feet—coast of Mexico 3 feet. The action seems to be that of a sudden lurch of the earth in its rotary motion."

"The great tidal wave of May 9 and 10 on the Pacific," says the St Louis *Republican*, "is an interesting subject of study. It was evidently the product of a great submarine upheaval, attended by a vibration of the earth over a vast area. The point of upheaval is thought to have been in latitude 22° west, and a short distance off the South American coast, about 5,500 miles south of San Francisco, and the time half-past 8 P. M. on the 9th of May. The wave traversed this distance in ten hours, reaching San Francisco about half-past 6 A. M. on the 10th, showing that it traveled at the rate of 550 miles an hour. It reached the coast of New South Wales, about 5,000 miles off, at 5:20 A. M. on the 11th, apparently a day later than it arrived at San Francisco; but as New South Wales is in longitude 150° east there is a day lost between the two places, and it is probable that an accurate calculation would show that its arrival in the two places was nearly simultaneous. Its most marked effect was on the Peruvian and Chilian, coast, where there was first a violent tremor of the earth and next an influx of the wave, which rose to the height of forty to fifty feet. At Valparaiso it exhibited itself at half-past 9 on the evening of the 9th, showing that the point of upheaval was about 550 miles north of that place. It is probable the whole Pacific Ocean shared in the disturbance."

The San Francisco *Chronicle* says: As yet the center of disturbance which produced the wave in the Pacific that destroyed Iquique on the 10th ult. is not ascertained. The direction from which it came may perhaps be determined by calculations from its time of reaching different places on the Peruvian, Californian and Sandwich Island coasts; and from the height to which it rose at different localities, especially on different sides of the Hawaiian group, where the variation of height was from 4 to 36 feet. Prof. Davison, of San Francisco, keeps a record of the height of the sea at that port by instrumental means, and he finds that the disturbance lasted for three and a half days after it began on the 10th ult., and that there was in particular a second shock ten or twelve hours after the first. About 2 or 3 a. m. on the 11th a shock of earthquake was felt in Perthshire, Scotland.

A correspondent of the *Christian Union* named S. Coan writes to that paper as follows: In February the whole kingdom of Hawaii was thrown into consternation by the eleventh and most remarkable of all Pele's eruptions,—Pele being the goddess of the volcano. In May a great tidal wave prolonged her agony. Of the latter, news has just come. Though the wave swept the shores of the entire group, it did the most damage at Hilo. Hilo, as the largest settlement on the island of Hawaii, always suffers the most on such occasions. On the 10th of May, at four o'clock in the morning, the waters of the bay began to rise and fall abnormally. At five o'clock they hurled themselves upon the shore to a distance of one hundred yards. In a moment the wharf, the warehouses, the shops, the native huts, the lumber piles, and a bridge that spanned a river tributary to the bay, were wiped out of existence.

The wide sand belt that girts the beautiful bay lies in a semi-circle.

Bordering this is an embankment fringed with cocoanut trees; and here were the buildings that were swept away.

The long curve of sand beach terminates in a rocky pile covered with cocoanut trees and called Cocoanut Island. On this picturesque island stood the hospital. The island was completely submerged, and when it arose from the flood not a vestige of the hospital remained.

With the news of this tidal wave—not the first visitor of its kind—comes that of the unusual activity of the crater Kilauea.

Pele retreated into the bowels of the earth, making her next appearance beneath the waters of Kealakeakua Bay, not far from the spot where Captain Cook was killed.

This subterranean eruption opened a fissure under water a mile long and extending inland three miles. The little inter-island steamer "Kilauea" came upon the scene of action just in time to find a boiling sea lying directly across her path.

Boats and canoes pulled into the turbulent waters, which danced like rapids. Blocks of red-hot lava, some of them two feet square, rose constantly to the surface and bumped against the boats, but did no damage. Many smaller pieces of lava were fished out of the hot water and found to be so molten that the interior could be stirred with a stick. A part of the time the surface of the sea was covered with these hissing-hot lava blocks. As they cooled they sank. The specimens obtained were all porous and light—a kind of lava called by old natives *aa*—pronounced ah, ah. The fishes in the vicinity were killed. Rumbling noises and a severe earthquake shock accompanied the phenomena.

The waves rose to a height of from ten to sixteen feet, perpendicular, at intervals of not less than four minutes. A whaler lying at anchor in four fathoms of water grounded as the waves receded, and was whirled around with every ebb and flow. Although the Hawaiians are the most amphibious people in the world (I have seen a child that could not walk taught to swim), five of them were drowned. Boats picked up others who were swept from the shore and swam until assistance came."

HYGIENE.

HEAT AS A REMEDIAL AGENT IN DISEASE.

BY PROF. GEO. HALLEY, M. D.

The use of heat in one form or another in the treatment of diseased processes, is almost as old as the history of our race. And yet, with all the accumulated lore of this nineteenth century, we find men styling themselves scientists, scouting at the very idea of there being any remedial qualities in it.

In every advanced form of civilization in the past, we find one or other forms of heat used as a means to combat, or as an agent to cure ailments to which the human body is subject.

The history of the bath in the city of Damascus is contemporaneous with the history of the city itself. So, also, among the Greeks, Carthagenians and Egyptians. But not till Rome had donned the plume of Empire do we find anything like a well systematized form of the bath in use. The great and patriotic minds of the day, as well as the popular panderers to the desires and tastes of the people, so fully recognized their utility that they had public free baths erected for those who could not pay for them, even though the bath at that time only cost a small fraction of a cent. Thus demonstrating that in their far seeing and patriotic policy, they recognized greater economy in preventing disease or checking it in its incipiency, than in curing it after it was fully established.

But not only as a remedial or preventive agency was it used, but as a luxury. They regarded it as a promoter of digestion, and so used it before meals to increase appetite, or even for purposes of gluttony and sensual indulgence, evidently showing they regarded it as a promoter of vital activity. It was on account of the licentiousness connected with the bath, or from the early Christians being excluded from them, that they almost entirely fell into disuse, after the fall of the Roman Empire—superstition in the name of Christianity taking the place of Pagan scientific Hygiene.

But among nations and tribes removed from that influence, we find it still used to a very large extent. Not only among nations with a history and a written language, but among barbarous tribes, such as inhabited this country. DeWolf, writing of the Mandin tribe of Indians, says, "When they became infected with small pox, they treated them with the hot bath, (hot air and hot vapor), with the effect of almost entirely stamping them out of existence as a tribe. But the fault is not in the agent, nor so much in the form in which it is used, but in not knowing when or how to properly use such a potent agent. It is indeed a "Damascus" blade, which in the skillful hand is powerful for good, while if used ignorantly, as it often is, becomes all powerful for evil. But in this paper I shall confine myself to the effects of hot air, all steam and hot water baths being nothing more than lavatories.

Hot air then requires for its successful application, when used as a remedial agent, a complete knowledge of the process of life, and the wonderful part played in biology by heat.

We are in the habit of speaking of the Hydro-Carbons as the heat producing agents in the body, and I suppose if I should ask every member of this audience the question "What are the heat-producing agents in the process of life?" I would get for answer, "The Hydro-Carbons." But is this true? You all know this is an age of investigation and thought. Theories that at one time passed unchallenged are now closely examined, and if at fault, corrected or cast aside. Nothing in science is accepted on faith. Proof and demonstration are always called for. What then is the part played in this wonderful process that we call vital by the Hydro-Carbons, and why is the theory at fault that takes them to be heat-producing agents? The soft parts of the body may be divided into two great classes—one containing carbon, hydrogen and oxygen; and the other in addition to these, nitrogen and some other substances of less import. The first are known as the Hydro-Carbons, and last as the Nitrogenized elements of the tissues.

Of all the chemical elements known, none show such a persistency in cutting loose from their combinations. There is no compound that has nitrogen as one of its constituents that will for any considerable length of time resist the ordinary forces of nature that are productng disassimilation. The Hydro-Carbons will. The Nitrogenized compounds are always found performing more or less active vital functions, as for instance in muscles and albuminoids in the blood. The Hydro-Carbons, as tissues, are never found performing vital functions in any department of life.

We might go through the whole range of both animal and vegetable life, and we should only find them occupying a negative or passive position in either, while the nitrogenized are always the positive and active. The reason for this will be found in this very unstability. In order to have vital manifestations it is requisite that there should be a great celerity of movement possible among the atoms of which it is composed, or in other words, it should be mobile, for it is only in mobile compounds we find vital manifestations. But molecular change is only one of the factors in this wonderful process we call life, for not only is it necessary to have this change, but it must go on according to physiological law and also according to the special physiological law of the organism in which it is taking place both as to quantity and quality, as well as to the thermal and hygroscopic conditions. When the whole process comes to be investigated we find so many things imperfectly known or not known at all that we are at times tempted to despond of ever knowing the whole process completely. Some few things, however, we do know, and while investigating these we may be enabled to discover more. The changes that take place in the animal tissues in the process of life have to some extent been investigated and some facts elicited. We know the change must be gradual, and while slow must at the same time be complete. It must be gradual in order that force may be produced in due amount, and at proper time. That time, in order to be normal must be at the bidding of the will, else we have a fit of epilepsy. It must be slow in order as much as possible to conserve tissue, prevent waste and relieve excretory organs of the great amount of excreta that would be cast on them for elimination.

Now, while we have been considering the changes that go on, the movements that take place among the elements of tissues, we must remember that Heat is duly one of the modes of motion, that those changes of form and combinations, arrangement and re-arrangements among those elements of tissue is only motion, and that motion is only a form of heat, in short, that Heat, Light, Electricity and Motion, if not demonstrably in every position and relation as the same, are so closely allied as to be, in most conditions, interchangeable, and that force—all forms of it with which we are acquainted—is but a manifestation of one of the forms of heat.

But we have shown that the nitrogen compounds are not only the most really changeable tissues but that it is those, and those only, that give vital manifestations, and that those vital manifestations are not only kept up and carried on by heat, but that they are themselves from the very nature of things the producers of heat. What purpose then is served by the Hydro-Carbons?

The terrible explosive compound known as nitro-glycerine is a fluid chemical compound of nitrogen. So also is the chloride of nitrogen, both having the consistency of oil. If nitro-glycerine is mixed with a substance that will separate its particles and at the same time destroy it as a fluid, it explodes it is true, but much more slowly though still with great force. It is on this plan the compound known as dynamite is made. If it is chemically united into a compound that is again mechanically mixed with other substances that still farther separate its particles though it is still explosive, it is much more slow, and if the mixture be capable of supporting combustion, as we find in gunpowder, we have more heat generated, for molecular change has been induced in the carbon, with which some of the gases now enter into new and simpler combinations. Now the vital process is carried on by the same means. But while the nitrogen compounds that give vital manifestations are in a fluid form they are very thoroughly mixed and chemically combined with other substances, notably the hydrocarbons. This would then appear to place them simply as dilutants, and sustainers of the combustion in vital process. It has long since been demonstrated that the heat producing process is not in the lungs but in the muscular and other nitrogenized tissues of the body. In intense febrile conditions it is not the fats or hydro-carbons that waste, but the muscles, blood and other nitrogen tissues. So well is the fact now determined that with a given fever heat the skilled physician can predict almost to an hour how long his patient will live. But each animal organism has its own specific temperature. As for instance, the temperature of the human race is about 98.5°, while that of some birds is 109°, a temperature at which human life is only carried on for a few hours. But in those organisms where waste is so rapid repair is equally rapid, in other words, the organism is nicely adjusted to suit its own requirements. So that in a state of health the normal temperature never varies to any great extent. It is true the muscle during exertion manifests a marked rise of temperature, but as soon as the exertion is over it again sinks to or below its normal temperature. This is what is known as the stage of exhaustion. But the tissues of the body are not at once changed from well formed albumen, for example, into completely prepared excreta that are ready to be eliminated by the proper glands or structures, but they must go through a series of changes. each new compound that is formed being more simple than the one that precedes it, until finally it either passes out of the organism as a gas or some solid that is completely and perfectly soluble in water, and all those changes must be effected by the aid of heat, though they themselves are productive of heat. But we saw that the changes in the nitrogen compounds produced succeeding changes in the hydro-carbons, which being slow in taking on molecular change keeps it up, so that heat started in the nitrogen compounds is kept up or sustained and prolonged by the hydro-carbons.

We have stated that in order to a complete accomplishment of this process there must be a constant and equal heat. But if from any cause the initial stage of transformation is accomplished and too great an amount of heat is drawn off or lost, or there is not communicated to the hydro-carbons the stimulating force to produce necessary change in them, there secondary transformations do not take place, and we find the circulation loaded with partially or imperfectly transformed substances, which now become poisons to the assimilative process. Nature, now, in order to get rid of them has, as we say, to make an extra effort to cast them off, but in reality, those poisons produce their own cure. They, by their presence acting as irritants, set up an increased disassimilating process, which means an increased heat, hence we have fever. Now while nature is, by this increase of heat, putting those partially transformed materials that were floating in the blood in a proper form for excretion, she is burning up or disintegrating more healthy tissue, and the cause of the first stoppage or imperfect transformation of tissue not having been removed there is still the same necessity for increased heat to effect the the transformation process, all of which means greatly increased waste of tissue, and consequently of force. But this expenditure of force was not normal either from cause or for effect, for if it had been normal from cause it would have been done at the mandate of the will or in the ordinary performance of vital processes, and if for effect it is entirely out of its range of action. Hence, one of its physical manifestations is impairment of the intellect, or delirium, or in other words, an abnormal expenditure of force on and through nerve tissues. In thus following the biological process, I think we have a complete explanation of the way in which heat acts in correcting morbid processes or "curing disease."

The high heat to the surface of the body—external and internal—accomplishes artificially what nature was trying to do from within alone, and that, too, without either the exorbitant waste of sound tissues of the body or increasing the quantity of imperfectly formed material in the blood, or in plain terms, a bushel of coal has done for the organism what the organism would have done by using up a large quantity of nitrogen of the body.

It may be replied to this that heat from without will produce the same amount of disassimilation as would have been caused by the fever process of nature. But experience shows this is not true. Tissues in a state of transformation in the blood are more powerfully acted on by heat than are the healthy tissues. For were this not so, the fever process would never be a curatlve, but always a poisoning and more rapidly destructive process than the one that set it up, a state of things every physician knows is not true. But heat applied to the surface promotes elimination by the relaxing effect it has on the skin and the sweating that is incident to the hot air baths. Friction, which should always accompany the bath, is another valuable aid in promoting circulation in the skin, and so exposing as much of the blood current as is possible to the action of the heat.

Having thus gone over in detail some of the reasons for using hot air as a remedial agent, we may conclude by summing up the whole matter.

Dry heat applied to the surface cures disease by hastening the necessary retrograde changes in the tissues that are already in a state of transformation, and fits them for elimination from the body, either through their own proper channels or by the sweating process carrying them out by the skin. It also hastens vital change in the healthy tissues, stimulates the gland structures and so aids in clearing the whole blood current. But it is not a cure-all, even though it does all this. To point out and enumerate all the diseases and diseased conditions in which it may be used with benefit would, in the present paper, be out of place. But in general terms I may indicate its range of usefulness as well as warn against its harmfulness, for, like all good and powerful agents, it is powerful for harm as well. The secret of obtaining good from its use lies in knowing *when* and *how* to use it.

All diseased conditions that owe their existence to imperfect assimilative or disassimilative processes, without organic structural change, will be benefited by a judicious and intelligent application of the hot air bath. But, on the other hand, there is a large class of diseases that are caused by structural alteration of glands, either accidental or otherwise; or there is another class that depend upon some form of ferment, poison, or living organisms, introduced from without, and when once within the blood current produce the most baleful effects. These the hot air will but slightly benefit, do no good to, or will act as a direct injury, appearing to hasten the process of disintegration that already is going on much too rapidly.

I have thus trespassed on your time from knowing the ignorance that exists on this subject, both among professional therapeutists and the masses of the people, and shall feel myself amply repaid if I have set people thinking in an intelligent way about this great and all powerful agent—Heat.

DENTAL PATHOLOGY.

BY A. H. TREGO, D. D. S.

Dr. Parmele, in the April number of the REVIEW, says: "The most frequent cause of the death of the dental pulp (nerve) is from medicaments applied by the dentist."

It must be admitted that procrastination on the part of the patient is the primary cause; after which the injudicious use of medicaments completes the "slaughter of the innocents." Another frequent cause is the unskilful use of instruments; as also packing the filling in immediate contact with the exposed, or partly exposed pulp.

Thorough knowledge of the anatomical and chemical structure of the teeth, with judgment as regards age, development, and other variable circumstances, are absolutely necessary toward constituting a "competent dentist."

All operators, however, are liable to expose *the point* of a pulp in excating cavities of any considerable size or to meet with extremely sensitive dentine immediately over the pulp. It is either of these cases that Dr Parmele alludes to. The remedy he leaves the ordinary reader and uneducated dentist to guess. Great care is necessary to avoid these sensitive points until the other parts of the cavity have been cleansed, after which mild narcotics or styptics should be used to allay inflammation. If, now, the dentine is sufficiently healthy and the pulp but little exposed, a safe operation may be effected by "capping" and filling.

The "fatal cases" are produced by the ignorant and indiscriminate use of cauterants, alkalies or acids "to obtund pain." Any one at all acquainted with therepeutics and chemistry ought to know that chemicals of that character will devitalize and destroy anything like flesh and blood with which they come in immediate contact. Hence the correctness of Dr. Parmele's assertion. However, arsenic, creasote, carbolic acid, iodine, chloride and oxychloride of zinc, etc., etc., are indispensable in a well regulated dental office; but, one application of any one of them to an exposed dental pulp renders extirpation absolutely necessary to the health of the tooth and comfort of the patient. I know there are operators who oppose this theory, who assert and believe that "when the nerve is destroyed the tooth necessarily becomes discolored and dies."

These same operators "obtund pain" (?) by use of the aforesaid chemicals, and the last thing before filling they cover the partly decomposed pulp with cotton saturated with creasote "to prevent the tooth from aching." If they have any knowledge of anatomy, what would they think of a surgeon who would attempt to hermetically seal such a powerfully decomposing agent in any other part of the human organism? Would he not be guilty of malpractice?

Aside from theory, practice proves that in a large majority of cases where pulps are "treated" and left in intense suffering and alveolar abscess is the inevitable result.

It is an established scientific fact, that a tooth not otherwise injured receives all necessary nourishment and vitality from the peridontium after the pulp has been extirpated and the channel properly filled. Also, that after ulceration and alveolar abscess have occurred, the surrounding parts may be restored, and the tooth rendered permanently healthy and useful.

After years of experiment and comparing notes, the leading authorities of the profession are unanimous as regards the modus operandi of devitalizing and extirpating dental pulps; as also of the necessity of filling the cavity with some substance that will render it absolutely impervious to moisture or gas, either by percolation or imbibition from the surroundings.

To devitalize a pulp: First, excavate the superficial decay and foreign substance usually found in decayed teeth, dry the cavity and apply "nerve paste," (arsenic and creasote), immediately on the pulp, by means of a small tuft of floss, cover this with cotton saturated with Sandarac varnish. Be sure to exclude all air and moisture, and not get any of the paste on the gums or lips.

Never apply arsenic while peridontitis exists. Leave the nerve paste in from ten to forty-eight hours, as circumstances demand; then remove it and cut away as much superfluous dentine as the condition of the pulp admits. Now apply creasote for from three to ten days, usually five to seven days; exclude moisture and air as before. Fungous growth of pulp may be treated similarly. As little arsenic and creasote as possible should come in contact with the bony structure of the tooth, as they will soon destroy it.

Arsenic "devitalizes," creasote "tans," or causes the pulp to "slough."

I prefer carbolic acid and iodine for fungus, abscess and necrosis, but use it sparingly in contact with the dentine, as it is liable to discolor the tooth by continued use. Never use cauterants in the cavity after the pulp is removed, except for abscess, necrosis, etc.

When the pulp has been made insensible it can be readily extirpated. Remove all of the pulp—to the apex of the fang, have the cavity thoroughly cleansed and free from inflammation, and as a final dressing before filling the fang, wash it out with a tuft of floss saturated with equal parts of tincture of belladona and aconite root. Tepid water, by means of a syringe, should be freely used in cleansing all cavities.

Until a few years ago the leading dentists considered gold the only proper material with which to fill "pulp canals." They roll a cone to supposed size, having it semi-solidified, and then guess how far to drive it in. Having everything in readiness, they dip the cone in creosote and insert it. If periostitis or abscess follows they attribute it to "exostosis," or to the patient "taking cold." A majority of cases treated in this way result unfavorably; first, because creosote is certain to produce decomposition, which is certain to find the easiest way out—through the alveolar.

Secondly, because it is a mechanical impossibility, in a majority of cases, to fill pulp canals perfectly with gold or any similar material.

Similar or worse failures occur with operators who use oxy-chloride of zinc, or similar cements. Many use the zinc for capping exposed pulps. If they will carefully observe they will see that the acid will disintegrate and destroy membrane, fleshy fibre, dentine, etc. Used as a capping decomposition of the pulp with all the attending evils, is as sure to follow as sparks to fly upward. As a filling for roots I have no faith in any of these "concretes," from the simple fact that in thousands of cases that have come under my observation, I have never seen a pulp canal made perfectly impervious by their use.

In a series of expertments in connection with a proficient chemist, I was incidentally led to try a compound of paraffine and caoutchouc for filling pulp cavities. Being readily applicable, and so superior to any metals or pastes then in use, it was presented to the Dental Colleges and Societies and pronounced perfect.

In 1866 I adopted the use of a compound of paraffine, gutta percha and feldspar—equal quantities. This preparation, when cool, is sufficiently hard for temporary fillings in surface cavities; is as easily worked as wax, and is perfectly insoluble, except by chloroform, ether and naphtha. Being applied in a semi-plastic condition, it fills every portion of the canal readily, and forms a cement that renders the walls perfectly impervious to moisture or gas.

I have used one or the other of these compounds for twenty years, and never failed to permanently preserve all teeth that I previously diagnosed susceptible of being restored.

After thoroughly testing this preparation and modus operandi, several proficient members of the profession have adopted the motto: "Never extract a tooth while there is a root to build a top to, or a top to build a root to."

HINTS FOR SUMMER BATHING.

Dr. W. H. Vail, M. D., well known as one of our best medical writers, gives the following sensible suggestions on this subject in the *Christian Union:*

As summer approaches, rules for bathing are apropos. Whether in bath-tub, river or ocean, bathing should be accompanied only by pleasurable sensations. The whole body should be kept aglow. If any shiverings or chilly sensations are experienced, either you are not well, the water is not of the right temperature, or you are bathing too long. At all events, such feelings are nature's warning that you should at once leave the water and give yourself a thorough rubbing with a coarse towel. Bathing, especially swimming, necessitates great muscular activity, therefore in order that digestion may not be interfered with, at least one hour, and better still two or three, should elapse between a hearty meal and bathing. It is easily seen that eleven in the forenoon, four in the afternoon, and just before retiring at night are the best times for bathing.

Some like a cold dash on rising in the morning. Very few, comparatively, can stand such a shock to their nervous system. Let those who enjoy it, and experience a glow during the operation, continue the practice; but let them be careful how they urge its adoption upon those whose nerves possess a less degree of resistance.

Any one desiring to acquire the habit of a cold bath every morning should begin the custom in the warm weather, continuing it during the winter, and not commence it in the latter season.

If you are perspiring from walking, rowing or other exercise, as you reach the place of bathing do not (as some advise) sit down on the bank to cool off before entering the water. Doff your clothes and dash in as soon as possible, only being careful to keep up the exercise without intermission after you are in the water. In this way you continue the glow which you experienced from the previous exercise.

Ten, or at longest fifteen, minutes in the water should suffice for the strongest aqueously inclined urchin. Strive always to leave the water before you feel chilly, or certainly at the first approach of any such sensation, and continue or rekindle the glow by a vigorous rubbing with a coarse towel.

Turkish superstition says wet your head thoroughly upon entering the bath; we say do it to prevent rush of blood to the brain, which event may cause death.

Finally, as bathing, apparently a simple process, is not without its dangers, we would warn all boys not to begin the practice too early in the season, or to repeat it too often daily. Many have found an early grave by over indulgence, while others have endured long years of suffering from the obscure effects of excessive bathing. No physician should consider it below his calling to give specific directions to all seeking his advice as to when and how long they should bathe.

COOL ADVICE.

It is quite worth while to mention the two or three preventives of great heat, especially at night, which in tropical climates Europeans have been taught by long and varied experience to adopt, and which only seem absurd to Englishmen at home from ignorance of the whole subject. The first and foremost of these is to keep quietly at home out of the sun and its temporarily injurious light. Englishmen in the West or East Indies, or in China, would be considered simply crazy if they walked about with the thermometer marking 100° in the sun, with their necks unprotected, as Londoners have been doing all this week. Experienced residents would tell them that no change of dress, no attention to diet, no carefulness about cleanliness, will give them half the serenity and comfort they will obtain from stopping at home; that when the thermometer ranges above 80° in the shade, the impact of the sun's rays is positively and directly injurious to the constitution, producing physical deteriorations which may affect them for life. Not only are the effects of a sunstroke permanent, and liable to reappear on hot days even in cold climates, but the effects of exposure to the sun, though not producing sunstroke, are often recognizable for years, producing, among other well-ascertained consequences, a distinctly separate liability to be affected by any form of alcohol—the key, we believe, to the extraordinary mischief drink works among the southern races, and the key also, most fortunately for them, of their instinctive aversion to liquor. It is not the heat, but the light of the sun, which produces these consequences, for a good umbrella prevents them; and the man who must be abroad in the light of days like last Tuesday should carry one as carefully as he does when he is only afraid of spoiling his hat. Two seconds will sometimes do the mischief, and he had much better bear being told that he is careful of a bad complexion than incur a permanent liability to suffer whenever he takes a glass with a friend. Next to keeping quiet, and as much out of the glare as possible, is the use of cool water in profusion, and that not only to drink, though water drinking is probably beneficial. Nature makes very few blunders, and the dislike of repeated draughts of water, which is shared, we believe, even by some physicians, is as irrational as would be a dislike of stokers to put on fuel where fire is needed. All the tropical races in summer drink hard of water—even the Bengalese, who, by pouring it straight into their throats, lose all its pleasant coolness in the mouth. The New York *Times*, we see, objects to iced-water. but the New York *Times* is only laughing at the teetotalers through a *bizarre* use of their alarmist phraseology. Water iced till it trembles on the verge of solidification, and taken after a full meal, may injure some weak stomachs; but water iced till it has the temperature of a cool spring will hurt nobody at any time or in any quantity whatever that an ordinary appetite is likely to crave. One would think, to hear some people talk, that thirst was in itself a good, instead of a symptom of exhaustion. But water has other qualities than the allaying of thirst. It has a permanent determination to evaporate, which nature obeys, and, as it cannot evaporate without heat, it positively diminishes in the process the heat of our rooms. Pans of water, the cooler the better, stationed about a bedroom will positively reduce, not the sensation of heat, but the heat itself. Let anybody who doubts that have his tub, with its shallow depth and wide surface, filled with spring-water, or water with a good block of ice in it, and placed in his bedroom, and mark in half an hour how many degrees the thermometer has fallen. It ought to be 6° at least, and will be 8° if he is not stingy with his ice, and the improvement, equivalent in comfort to a fire on a winter's night, will last for hours. If that is still insufficient, let him throw up his bedroom windows, fasten an old blanket or traveling-rug across the space, and drench that well with water, and in five minutes the air in the room will be reduced to that water's temperature. Never mind about breeze. The air will seek the cooler place itself, without being driven in from the outside, and the temperature will decline almost instantaneously to a reasonable point. Not one of these expedients necessitates any change of habits, or any expense whatever, though of course a shilling or two laid out for ice will make the improvement more rapid, and in the case of a sick room, or of any one who really suffers from heat—suffers as if in sickness, we mean—will be money will laid out. And so in the case of little children, especially, will a few shillings on the sheet of woven cane—we have unfortunately forgotten the trade name—which is used in the hottest corners of the East Indies and China for pillow-cases and sofa-covers. The silica with which this material is coated will not get warm, and every other covering for beds or pillows with which we are acquainted will. It keeps perfectly dry, cannot get dirty, and can be procured as soft as any covering that ever was placed upon a mattress. There is hardly any luxury like it in intense and stifling heat, and we have known sick people, half maddened with heat acting on exhausted frames, sleep on it when sleep seemed otherwise unprocurable. With plenty of wholesome water, wetted blankets for window-curtains, and a sheet of cane, no one in London ought to be rendered sleepless by heat, or indeed, unless he presists in gorging himself with the food which he needs only in cold weather, to suffer any appreciable discomfort. —*Spectator.—Popular Science Monthly Supplement.*

SUNSTROKE AND ITS TREATMENT.

The sudden accession of heat has already produced one fatal, and more than one severe, case of sunstroke in the metropolis. Probably the affection so designated is not the malady to which the term *coup de soleil* can be properly applied. The condition brought about is an exaggerated form of the disturbance occasioned by entering too suddenly the "hot" room of a Turkish bath. The skin does not immediately perform its function as an evaporating and therefore cooling surface, and an acute febrile state of the organism is established, with a disturbed balance of circulation, and more or less cerebral irritation as a prominent feature of the complaint. Death may suddenly occur at the outset of the complaint, as it has happened in a Turkish bath, where the subject labors under some predisposition to apoplexy, or has a weak or diseased heart. It should suffice to point out the danger and to explain, by way of warning, that although the degree of heat registered by the thermometer, or the power of the sun's rays, do not seem to suggest especial caution, all sudden changes from a low to a high temperature are attended with danger to weak organisms. The avoidance of undue exercise—for example, persistent trotting or cantering up and down the Row—is an obvious precaution on days marked by a relatively, if not absolutely, high temperature. We direct attention to to this matter because it is obvious the peculiar peril of overheating the body by exertion on the first burst of fine weather is not generally realized. It is forgotten that the increased temperature must be measured by the elevation which has recently taken place, not the number of degrees heat at present recorded. The registered temperature may be more or less than that which occurred a year ago; qut its immediate effects on the organism will be determined by the conditions which have precede it and violence of the change.—*London Lancet.*

As the heated term approaches, the rules for the prevention and treatment of sunstroke gain new interest. The Board of Health has collected some information upon this subject in the form of a circular. Copies have been printed in English and German, and are to be circulated through the city very soon, especially among the laboring classes. The following is the principal part of the report:

Sunstroke is caused by excessive heat, and especially if the weather is "muggy." It is is more apt to occur on the second, third and fourth days of the heated term, than on the first. Loss of sleep, worry, excitement, close sleeping rooms, debility, abuse of stimulants predispose to it. It is more apt to attack those working in the sun, and especially between the hours of 11 o'clock in the forenoon and 4 o'clock in the afternoon. On hot days wear thin clothing. Have as cool sleeping rooms as possible. Avoid loss of sleep and all unnecessary fatigue. If working indoors and where there is artificial heat—laundries, etc.—see that the room is well ventilated.

If working in the sun, wear a light hat (not black, as it absorbs the heat), straw, etc., and put inside of it on the head a wet cloth or a large green leaf; frequently lift the hat from the head and see that the cloth is wet. Do not check perspiration, but drink what water you need to keep it up, as perspiration prevent the body from being overheated. Have, whenever possible, an additional shade, as a thin umbrella, when walking, a canvas or board cover when working in the sun. When much fatigued do not go to work, especially after 11 o'clock in the morning on very hot days if the work is in the sun. If a feeling of fatigue, dizziness, headache or exhaustion occurs, cease work immediately, lie down in a shady and cool place; apply cool cloths to and pour cold water over head and neck. If any one is overcome by heat send immediately for the nearest good physician. While waiting for the physician give the person cool drinks of water or cold black tea, or coffee, if able to swallow. If the skin is hot and dry, sponge with or pour cold water over the body and limbs, and apply to the head pounded ice wrapped in a towel or other cloth. If there is no ice at hand keep a cool cloth on the head, and pour cold water on it as on the body. If the person is pale, very faint and pulse feeble, let him inhale ammonia for a few seconds, or give him a teaspoonful of aromatic spirits of ammonia in two tablespoonfuls of water with a little sugar.—*New York Tribune.*

THE FEEDING OF INFANTS.

Dr. W. Faussett, in an interesting article on this subject in the *London Medical Press and Circular*, arrives at the following conclusions:

First—That aliment should always be presented to the infant stomach in a perfectly fluid form.

Second—That as bread and farinaceous substances generally have been proved by experience, and recently by numerous post-mortem examinations, to be often indigestible, and to have led directly to infant mortality, such substances had better be excluded from infant feeding.

Third—That cow's or goat's milk, when pure and modified as much as possible to resemble human milk, will often be found sufficient, without any other help, to nourish the new-born infant.

Fourth—That as cocoa contains all the elements indispensable for the growth and development of the body, and can always be presented in a fluid form, it is, next to milk, preferable to all other natural substances as an article for infant aliment.

There is one other point, which, though only indirectly connected with infant feeding, is one of paramount importance, as regards the present and future health of the individual, namely, the necessity of guarding against the hateful practice of covering the child's face as it sleeps.

The mistaken kindness and over-zealous attention of nurses in excluding the pure air of heaven from entering the lungs, in order to guard against the effects of cold, will often be exhibited in the soft, pale flabby condition of the infant's body, while a cachectic condition of the blood will be insidiously generated, which must prevent the infant thriving for the present, and possibly may lay the foundation of tubercular and other diseases in after-life.

POPULAR EDUCATION.

SCIENCE TEACHING.

BY PROF. E. C. CROSBY.

[Read at State Teachers' Association, June 28, 1877, Sedalia, Mo.]

I propose to state the correct method of teaching science, some of the errors of our common methods, and some thoughts upon the intellectual and moral results of such teaching. An English philosopher has defined the word "science" as a correct interpretation of natural objects and their phenomena; a comprehension of law wherever law prevails. It will be assumed that the senses are the pioneers of all knowledge, and that whatever is learned as absolutely new must be comprehended by the plan of Froebel.

With lemon in hand the teacher stands before his inexperienced pupil; biting it, he says "It is sour," and the statement is repeated by his pupil. After pressing the lemon the teacher says it is elastic, repeated by the pupil. Now, stating the language of the teacher, he says, "The lemon is sour and elastic." What has the pupil done? Pronounced two words and has seen method. What more has he been taught? Nothing. The pupil must taste and press the lemon, or, from it, he can never know these properties. This knowledge is absolutely experimental; the meaning of these two words can never be communicated. In this case the teacher's faculties of perception have been improved, and his stock of knowledge increased. The pupil has vocalized two words having no meaning—has been crammed.

A pupil secures a bladder to the receiver of the air pamp. Taking the handle he experiences the effort that moves the piston, withdraws the air until he hears the roar and feels the blow of the shivered membrane. Now the text book is consulted, ideas are generalized and the understanding enlarged. Thorough, definite, exact and unmistakable is his knowledge. Now he rises in class to recite a living knowledge gained from a personal investigation of the subject, and not what he is able to reproduce from memory of what some one has said about atmospheric pressure. It is ever true that the nearer the person is brought, by the use of his senses, to the phenomena which he wishes to know, the more rapidly does he cultivate his faculties, acquire method and obtain knowledge. In all education the idea should precede the technical term which designates the object. As the definition is the result of certain physical processes, it must ever succeed a knowledge of the object and not precede it. A western school report contains a recommendation to the school board to place a complete set of weights and measures in the primary departments—these should be in every school in the state. Burke long ago said what every practical teacher knows, "I am convinced that that method of instruction which most nearly approaches methods of investigation is the true method." How does such a knowledge and discipline compare with the weak, pallid and hollow words recited by the pupil who has only seen the text book! Incomprehensible as may be the association of the intellect and the brain, there is no doubt, that, to the extent that this organism is affected by the sensation of the different senses, does knowledge become more tangible, objective, definite and real. While dissecting a shark and puzzling over an unknown organ, I asked Prof. Agassiz its name. "First find out all that you can about it, then I will tell you," he answered. Who does not see the method and philosophy of teaching in this remark? At another time he said: "I hope you have brought no books, for I don't want you to read." "When we study books we are prone to remove away from the things we study." "You must consider things unknown to you as unknown to science." With regard to physical science Prof. Huxley says that mere text book work is a sham and a delusion, while Guiot has added the warning that "The bane of our school work is the confounding of knowledge with memorization." It was Bacon who advanced and stoutly defended the view that science teaching in our schools should be made intuitional, living and practical.

The pupil commences mechanics. He has studied no books upon the subject. He places the load at one end of his lever—a bar of iron, or a piece of board—near which is the support or fulcrum, and his hand pressing downward at the other end; he removes the support now toward the power and now toward the load, measuring the distances, performing calculations and determining results—knowledge in its true and only sense is acquired. No more interesting sight can be witnessed than a class of young ladies and gentlemen exercising the mental powers. By more exact methods they now proceed to ascertain the well known law of the lever. How? Not by such mystical conceptions advanced by Aristotle, that such a motion of the lever is in accordance with nature, and such a motion is contrary to nature, but by the method of Archimedes who first gave us the law—by absolute experiment. Let us note that in the study of the lever the senses of the pupils, the faculties of mind have been exercised and disciplined by bringing them into direct contact with the objects of knowledge, instead of what some one says about them. The observer's powers have been employed, the habit of attention gained and the necessity of exactness felt. He has applied his power of comparison, generalizations have followed and the understanding has been enlarged. He has seen the problem and felt the obstacles, and strengthened by the conquest and cheered by his successes, he is fresh for another subject.

Now to the teacher's work. What has he done? Exhibited the experiments to his class? No. Exercised his own faculties instead of his pupils? No. Has he imparted any information? No. Crammed his pupils? No. Then what has he done? He has most marvellously kept his mouth shut. I am daily more convinced that the work of the teacher is, primarily, not to impart knowledge but to abstain from imparting knowledge. Stated differently, successful teaching is that kind of direction which enables the pupil to acquire for himself. But life is short, says one, and the much in the little which it is possible to learn, requires time. Shall the pupil be abandoned to aimless and uncertain trial, to the fate of fortune, to the haphazard successes of the laboratory for the acquisition of knowledge? Kepler wrought thirty years, successively testing nineteen different hypotheses, before he discovered the form of the planetary orbits, while the world has been many thousand years in learning the nature of combustion. It is here that the directing power of the teacher avails in placing the pupil in the way that he may acquire for himself.

I am satisfied that the most of the work of pupils should consist of an exercise of faculties, instead of memorizing the finished knowledge of those who have obtained it by such exercise; that one of the principal aims should be the acquisition of method; that these mental processes should be concentrated upon the objects which alone develop them; that a knowledge of the object should precede a knowledge of its name; that a knowledge of the thing defined should precede the definition; that a knowledge of the relation of facts should antedate their form of presentation; and that conceptions, standing out in clear relief, should precede an opinion. Not long hence will our text books be founded upon the fact that education is the development of faculties by use, rather than upon the theory that the mind is an elastic receptacle that will indefinitely expand according to the quantity of finished knowledge poured into it. The best that instruction can afford, and the aim with which it should be given, is, first of all, to cultivate the powers of observation, analysis, comparison and judgment; second, method of investigation; third, knowledge. Such a course of teaching impels the student to examine an object before him, instead of what some authority says about it; to consult his own good sense and experience, and to rely upon his powers —the same powers which he will daily use through life—instead of consigning them to the purleius fear and distrust.

Knowledge! knowledge! is the cry upon all hands, and teachers everywhere are more diligent in imparting it than in developing the "muscle and brain" with which the pupil may acquire it for himself. So wild and great is the rush for knowledge, that we have overlooked the psychological conditions of its acquirement, and now find ourselves buried in the exclusive study of books and drawing pictures, dignifying the work by such expressions as "teaching botany," "teaching zoology." The great want of educational system is method and not knowledge. The old adage that "knowledge is power" has rightly been called false, for it is perfectly true that only so much of knowledge, that has been gained by the natural processes of acquisition, involving the use of faculties, is power. Teaching for the sake of knowledge is the work of the crammer, and it is too common that solid acquirements are measured, not by the capacity to comprehend, apply, and originate, but to recite by the yard. Cram has been very aptly defined by an English lexicographer, as a species of intellectual feeding which is neither preceded by appetite nor followed by digestion. The work of the boy who wrote upon the board, "Bacon wrote the 'Novum organum' and the 'Instrationara Magna,'" is daily equaled at the cramming feasts where are served up such dishes as abridgement, appositive, future perfect, auxiliary, recurrence, definitive, trochaic, intransitive and subsequent. The time is fast approaching when the common school will teach the use of the English language, leaving its technical details and abstract philosophy to the maturer minds in the higher schools of the States.

In support of the above views, let me read from the pen of Dr. Whewell, "The most obvious method of affecting this discipline of mind * * * is the exact and solid study of some portion of inductive knowledge as botany, geology, comparative anatomy and chemistry. But I say the exact and solid knowledge; not a mere verbal knowledge, but a knowledge that is real in its character though it may be elementary and limited in its extent. The knowledge of which I speak must be a knowledge of things and not merely the names of things; an acquaintance with the operations and productions of nature * * * and not merely what has been said about them; a knowledge of the laws of nature seen in special experiments and observed before they were conceived in general terms * * * by such study of one or more departments of inductive knowledge the mind may escape from the thralldom and illusion which reigns in the world of mere words."

What then should form the basis and material of an educational system? "Utility," "the demands of the Age," "The claims of the Past," "The wants of the Future," have each been proposed. It is not a little interesting to trace the growth of the view that the nature of the mind itself should form such a basis, in the champion efforts of Comenius, Bacon, Rousseau, Schopenhauer, Lankoster and Rosenkranz, down to our own Pestalozzi and Froebel. It should be remembered that our theories of education and the science of education are not necessarily synonymous terms. To this fact theories must give room—the essential character of all knowledge is experiential. The strength of this position is in part illustrated by the fact that he who has never experienced bitterness, transparency or an electric shock, for instance, can never receive from others more than their empty names. This knowledge is absolutely incommunicable, and it is thus with all knowledge, which an analysis of the character of knowledge abundantly proves. We may point the way by which the pupil may acquire it, but to communicate new truth is utterly impossible. "How then," says one, "are we able to tell a person what he did not know?" We can not. He who is able to understand or receive the proffered information must do so by marshaling his past psychical experiences in the order mentioned by the informant. Should it contain a single item or element that has not been experiential with the learner, he is in the fog, and, no matter how great his anxiety, utterly incapacitated to accept (understand) it. More important than all other facts and stranger than any fiction does the bearing of this truth have upon our educational system. The illustration and proof of this position would lead us to consider the nature, office and certainty of symbolic knowledge, which our time will not allow, but it may be satisfactorily wrought out by each individual teacher. Our conclusion, then, is that the advancing knowledge of the pupil depends wholly upon psychological experiences, and these in turn result only from physiological ones. Beside the deep, safe and buoyant sea of presentation we lie stranded, half wrecked upon the shoals of a so-called representative knowledge.

If science teaching should be made practical, where is the time for the work? The time when a man can compass the whole field of human knowledge is past, for there is scarcely a single department of study that can be mastered by one individual. In the language of a great man (Ag.), "We must be contented to know *little*, but to know that little well." However, when we shall have lopped off that great mass of useless stuff, the acquirement of which neither brings discipline nor intelligence, we shall have time to accomplish much. The most of our mental arithmetic drill might very sensibly step down and out to make room for the elements of botany and zoology, while circulating dec. Permutation, annuities, duodecimals, principles of L. C. M. & G. C. D., progression, the extraction of the fifteenth root, arbitration and the endless details of geology and grammar, plunder the time which rightfully belongs to physiology, natural philosophy and chemistry.

Every performance of duty, every calculation, every forecasting of probabilities, and every act of life, is performed by the judgment and not by the memory. Science most completely prepares one for this work. Many branches, now excessively taught, do not afford a field for the free exercise of judgment, and largely such is the character of the classics, history and the mathematics. These present inviting range on the sole condition that the pupil admits certain facts, definitions and axioms, and from these, not losing sight of them for a moment, "he advances in the groove of thought," which has been so unkindly marked out for him. It is noticeable that the problems in arithmetic contain only those factors necessary to a solution. To a certain extent he loses his personality, while his individuality is not only hemmed in by boundary walls but is finally swallowed up by the authority of the teacher, and the well picketed gulf of the lexicon. In life, the facts with which he deals have been classified by no kindly hand, and among these diverse interests, conflicting elements, the strange objects and the stranger phenomena, he stands perplexed, confused, and well nigh powerless. Each person commands the art of reasoning to the extent that he has not learned its formulæ, varieties and rules, but practiced them (whether or not they have been definitely formulated). The formation of judgments and the processes of reasoning are practiced by the race, inexactly by the many, tolerably by some, and correctly by a few. Science appeals to individual reason and individual responsibility; its truths are determined by no authority but nature herself; it furnishes a knowledge of what is and, to a limited extent, what is not; it teaches us to distinguish what is known and what is probable, and to know facts as distinguished from their various interpretations. Dr. Porter says that in the education of the judgment science has no equal. How many problems in life there are, whose solution depending only upon judgment, awaits a master mind—corporal and capital punishment, suffrage, legislation, recreative amusements, Sunday laws, rights of citizenship, capital and labor, prison discipline, currency, intemperance, taxation and Prof. Tice. Only the most thorough culture of the mental powers, by use, can enable the race to cope with the ever-increasing demand of civilization, even in a tolerable manner. Witness, too, the one hundred "isms" that press their claims for man's recognition. One demands a faith which rests upon certain phenomena, while the phenomena allow examination only on conditions that forbid acceptance; another, a belief in the invariability of the so-called natural laws whose universality investigation has rendered only probable; another, an uncritical faith in authenticated history, whether it accords with or contravenes the use of good sense.

The present age demands what the past did not require, and it is probable that the future will not be satisfied with that which satisfies us. Educational requirements change and systems grow. It has not been long (1771) since the University of Salamanca refused the admission of physical science on the ground that Newton taught nothing that would make a good logician or metaphysician, and, "as for Gassende and DesCartes, they do not so well agree with revealed truth as Aristotle does." The present age demands that both science teaching and scientific teaching shall permeate the whole educational system, not for its discipline alone, but for its other results. He who believes that they should become something more than mere "optional" studies upon the ground of mere utility, assumes a not impregnable situation, but, if it can be shown that, while it serves the purpose of use, it embraces a thorough discipline of the faculties and contributes to intelligence, it has my support.

The new fields of inquiry, of striking and exhaustless interest opened up by scientific researches, astonish by their number, gratify by their freshness, and captivate by their singular attractions. Thanks to the balance of Coulomb, the achromatic of Dollond, the micrometer of Gascoyne, the dividing engine of Rameden and the chronometer of Harrison, the world has extended its field of research into the realms of matter and meditation 300,000 to 400,000 times as far as was known to Middle Age life and the old Chaldeans. The millionth of an inch in space and the millionth of a second in time are noted with accuracy. Davy said that nothing so much tends to the advancement of knowledge as the application of a new instrument, while the historian of science (Whewell), refers every great intellectual advance in education to the effect of some scientific discovery. Is it not very probable that the acquisition of these new fields are preceded by close application? And is it not probable that occupation in these fields of inquiry should not result most favorably to the mental capital of the state and country? I will not mention the departments of science—it embraces life.

One of the principal advantages resulting from the scientific pursuit of science, is the ability to suspend judgment or to reserve it, until an examination of the case has been made. Hourly is the student of science compelled to practice the advice of Jacotot to his pupils at Louvain. "In all your learning do homage to the authority of facts." How easy in life it is to see those facts which favor our views of any subject, and how conscientiously do we fail to see the application or parallelarity of those which oppose them. Multitudes—not all of them outside of our profession—are ever ready to pass judgment and draw conclusions at first sight, in a very dogmatic manner, neither thinking of the necessity of an investigation, nor knowing even the laws of an examination. They neither realize the unreliability of testimony, the urgency of timely precaution nor the nature of evidence. Who does not see the profound abyss between the knowledge that an examination should be made and the ability to make that examination; between the knowledge that precautions and allowances must not be overlooked, and the untrained ability to act with prudence and allow with safety;

between the knowledge that all factors must be collected and classified, and the ability to collect and classify them. In the light of these facts science studies again appeal to us for a change of venue from the "optional" to the "required" course in the curriculum of education. Reservation of judgment is almost unknown, and he who practices it is considered mulish and intolerably ignorant. So very common is the unconsidered judgment that it is very probable we need not leave the town of Sedalia to find hundreds who accept or reject the theory of Darwin with equal certainty and confidence, neither of whom pretends to know anything of embryology, structural differences and affinities of geologic history. So thorough is this popular delusion that we must have some settled opinion, that most any of our unprofessional neighbors, at the first request, will not hesitate long before expressing his opinion upon the fluidity of the earth's interior, the result of the eastern war, the nature of the sun's heat supply, or Snell's discovery of the relation of incidence to the trigonometrical properties of the line. The time is not far distant when it will be considered that he who makes assertions ought to be competent to investigate them. These evils—not harmless in their character—cannot be corrected until a radical change is effected in our course of instruction. The order of mental processes is based upon the perceptions; from these perceptions, manifold in variety, conceptions are formed; the consideration, comparison and discrimination of conceptions from the reasoning process, and from this is derived the final judgment or conclusion. If any of these processes have been incomplete or wanting, to that extent is the conclusion vitiated or worthless. From a mistaken view of the antecedents and character of knowledge, we have the popular delusion that by simply reading definitions and generalizations in science, we thereby become scientific men, in full possession of scientific minds, able to see the full scope and bearing of scientific research, endowed with full authority to draw its boundary lines and make all needful and necessary restrictions. But the result of simply reading science is far different from this. The convincing power of a conclusion drawn from the domain of science is felt and known by an experimental knowledge of the data upon which the generalization rests. It is he only, who has had this experience, that knows the intricate and obscure phenomena, the grand evidences and the mazy labyrinth leading up the luminous track track to knowledge. The real and potential value of knowledge obtained by the developing effects of experience clashing with the alternately hopeless and treasured theory of a loved ancestry, obtained by the tortuous and tentative ways of truth-loving zeal, can not be picked up by the purposing nut gatherer of knowledge. Simple memorization of facts or their relations is neither the acquisition of science nor scientific power. If science includes the classification of facts it equally includes the classification of experiences. When, then, a public speaker expresses his opinion quite confidently upon a conclusion in science, before even a limited amount of confidence can be given, the listener is compelled to ask, not whether he is a Mahommedan, Greek, Christian, Paulist, Deist, Rationalist or soft money man, but whether he knows of what he is speaking or has simply read up on the subject.

I wish to point out an intellectual result of science teaching, which, in its general character is felt rather than professed. Under the attentive eye of the student the electric current slowly decomposes the water, but, be the quantity little or great, the volume of hydrogen obtained is always exactly twice as great as the volume of oxygen. Repeating the experiment, under all possible conditions, the result does not vary. He tries rain water, salt water, the water from springs and rivers, but with the same unvarying proportion of two to one. Reversing the process of analysis, he takes two gills of hydrogen and mixing it with one gill of oxygen, and applying the heat they condense to form water again. Again he uses the same quantity of hydrogen, but two gills of oxygen; heat is applied, the same quantity of water is formed, but his extra gill of oygen remains. What can prevent this student from the belief that the water is not only constant in its composition, but that the force which binds its elements together is constant and invariable. He next takes common salt and has found by exhaustive experiments that of every 58½ pounds, 23 pounds are a peculiar metal, so light that it not only floats upon water but vividly burns on it, and that the remaining 35½ pounds are a stifling, green and poisonous gas. By various decompositions and recompositions he finds that the proportions are invariably uniform. Thus he studies the various facts and phenomena of nature —the fall of bodies, the resistance of fluids, the correlations of heat and motion, the interdependence of the two kingdoms of life, and stands convinced —self convinced—of the principle of uniformity in the action of forces and the universality of law. This idea has taken no slight hold of him. It is not a hollow profession to be used when convenient, but it is a part of his mental life, entering into every consciousness. In no case has an atom of matter terminated its existence, and nowhere has nature appeared inconsistent or capricious, Forces may, at times, have eluded his search, but nature never impresses him as extravagant and monstrous. The conclusions of uniformity in the processes of nature become knowledge in its true and only sense, as it is founded in perceptions, generalized into conceptions, wrought into reason and solidified into an indubitable conclusion. From these studies, he consistently, necessarily infers the existence of uniformity in other departments of human thought, no matter how great the authority to the contrary. The scientific study of nature powerfully predisposes to the idea that order reigns throughout creation, unmistakably effecting a state of mind that sees in the unknown an exhibition of law instead of chance, stability instead of vacillation, order instead of entanglement, and sincerity instead of duplicity. Science teaching requires the student to observe, analyze and compare; to combine and separate experiences; to search for the source of feelings; to question the views which he once held or now holds; to enlarge the requisites for proof; to suspend judgment; to revise with impartiality. It is such discipline that develops the healthful and manly condition of mind that sees folly and stupidity in that narrow dogmatism which represents doubt as essentially sinful.

It is not probable that mankind will soon agree about the phenomena that surround and embrace life. The pick of rational investigation has too recently commenced its descent into the rich placers of the great unknown. Although the spirit of intolerance has not entirely made its exit, the habit of constantly appealing to the sources of knowledge, which requires us to lay aside old prejudices and yield to candid investigation, will effectually effect a good work, the importance of which we cannot now realize. The habitual examination of nature with instruments "appropriate to its study" cannot fail to produce a marked advance. I say "appropriate to its study" for all possibilities, probabilities and facts, must be derived directly from the objects to which they relate. The Archbishop of Salzburg was certain of the impossibility of the globular form of the earth, as, otherwise, a world of human beings would be beyond the reach of salvation. Theological arguments are instruments of power, but their leverage must be confined to the work for which they are fitted. In the minds of some the impossibility of the globular form of the earth was settled by the certainty that those people upon the other side cannot see Gabriel when he shall come to us.

We have not far to look back to find such phenomena as lightning, eclipses, the rainbow, explained by inferring the agency of evil spirits and theological conditions; and still more recently do we see the volcanic eruptions of Vesuvius brought (?) to a condition of repose before the august statue of St. Jannorius carried through the streets of Naples, followed by an insensate procession of its citizens, and to-day, on the crowded coasts of Sicily, we witness reverence upon bended knee, with lowered heads and folded arms, at the approach and passage of the public teacher along the streets. So profound has been the belief that evil spirits tamper with matter, setting aside its laws and intriguing with men and old women that we need feel no surprise at the persecution of the ancient philosopher, because he stated that the sun may be as large as all Greece (Airy). When, too, we recall the all but unanimous belief that the study of matter materializes our conceptions, and induces skepticism, hereticism, and sinful doubt, we are better able to repress the feelings rising within us, while contemplating Servetus "roasting for two hours at the stake prepared by Calvin, begging "for the love of God that they would put on more wood, or end his torture." Science Teaching solves the problem of toleration, for our ability to exercise it depends not upon loved and honest professions, but upon exactly the same laws as the faculties of generalization and reason. We may read the conditions of perception and the laws of reason, but to perceive with accuracy, and to reason with ability, requires a discipline, a use of these faculties upon the objects which exercise them. Likewise, we may see the propriety and justice of toleration, but the ability to tolerate when toleration is most needed, follows only an exercise of the moral sense upon objects that call it into real use.

SCIENTIFIC MISCELLANY.

"CLEOPATRA'S NEEDLE."*

The obelisk known as "Cleopatra's Needle" is of great historical interest, because it had sculptured upon it the history of a man who quarried it from the old quarries of Syene (the modern Assouan), and the reason why he quarried it. There were few monuments extant, so far as we know, which could, like this, date back 3,400 year. In addition to its historical interest, however, the obelisk in question was of interest to engineers, in consideration of the means which were resorted to in order to quarry and transport in safety such a huge monolith. Cleopatra's Needle was not alone among obelisks, and possessed no peculiar features. In point of size, it stood only about eighth or ninth on the list of obelisks with which we were acquainted. The largest of which we knew was the Lateran Obelisk in Rome, which was brought by the Romans, with about twenty smaller ones, from Egypt, as the most curious objects they could lay hold of to decorate their imperial city. The Lateran Obelisk had a height of something like ninety feet, and was ten feet six inches square at the base, whereas Cleopatra's Needle was only sixty-nine feet three inches high, with a base of seven feet square. Ten years ago, when the lecturer was in Egypt, his attention was especially directed to this obelisk, which he saw lying in the sand on the shore at Alexandria. He dug around it and under it for the purpose of examining it, and it appeared to be little the worse for wear except that two of its sides were somewhat weatherworn, and did not retain the polish which still existed on the other two sides. Nevertheless, the hieroglyphic inscriptions were quite distinct enough to be read by the learned in these matters, and it therefore retained its history as clearly as on the day when it was set up by Thothmes III., *circa* 1400 B. C. Egypt in those days was the leading country of the world, not only in arts and commerce, but in learning and science, and to her great university of Heliopolis came Strabo, Pliny, Herodotus, and others. Thothmes went to the old quarries of Syene for the material of his obelisks. From these quarries for generations before him the Egyptians had been accustomed to sculpture those great blocks of granite which even to this day were our wonder and admiration. The granite of Syene was micaceous and somewhat coarse in texture and pinkish in color, and in the quarries, to the present day, there existed an obelisk, half cut out, much larger than any other we knew of. That obelisk, if it had ever been completely quarried and set up, would have been ninety-six feet high and about eleven feet square at the base. The proportion of height of these obelisks to the square of base was gen-

*A paper read before the Civil and Mechanical Engineers' Society.

erally about ten to one, or, in other words, the height was about ten times the square of the base. The hieroglyphics on "Cleopatra's Needle" were from two feet to three feet long, cut two inches deep and three inches or four inches broad, so that they could be read from a distance of fifty or sixty yards. The inscription, besides recording the virtues and power of Thothmes, recorded that the obelisk when set up was tipped with gold. This feafeature was of course gone, but there was a slight ledge round the point at the top which was no doubt made to receive a gold tip, or one of bronze gilt. On the top of the obelisk of Luxor at Paris, which the French brought from Egypt, there was a similar ledge or groove. The inscription on Cleopatra's Needle did not say in what city that obelisk was set up. Some accounts had it that it was first erected at Thebes, and was afterwards removed by Rameses to Memphis. Be that as it might, it was ultimately removed to the ancient city of Heliopolis. The site of that city, once the Oxford and Cambridge of the world, and at that time, it may be presumed, covered with magnificent buildings, now presented one of the most astounding spectacles which could be witnessed. Nothing remained but a green plain, in the center of which was a solitary obelisk, opposite to which once stood the stone now known as "Cleopatra's Needle." The latter was subsequently removed to Alexandria. How it came to be thrown down in its present position nobody knew. It had been conjunctured that an earthquake was the cause of its overthrow, but it was much more likely, Mr. Dixon thought, that it was thrown down to get at the bronze tortoise on which it was believed all these obelisks were placed. In 1798 the French conquered Egypt, and they laid their hands on everything that was valuable or invaluable in the country. They carried off an enormous quantity of Egyptian remains, and they proposed to carry off the Rosetta stone (now in the British Museum), Cleopatra's Needle, and other antiquities. Before they could do so, however, they were driven out of Egypt by the English, and at the conclusion of that brilliant campaign, in which Sir Ralph Abercrombie fell, a great effort was made to secure Cleopatra's Needle, which would when erected in London, form a fitting monument of one of the most brilliant campaigns in which English arms had ever been engaged. The army subscribed four or five days pay, and assisted by the navy, took steps to remove the obelisk. They had hardly commenced, however, ere the red-tape and pipeclay of those days sent forth an order to desist in the attempt, as such work would be destructive of discipline and of the accoutrements of the men. So the obelisk remained where it was. When Mehemet Ali assumed the reins of power, he, wishing to please George III, presented the Rosetta stone and many of the principal objects in the Egyptian Court of the British Museum, together with Cleopatra's Needle, to the English nation. The British Government, however, had always declined meddling with this obelisk, although repeatedly urged to bring it over. The expense involved was made the great obstacle, although even so utilitarian a man as Joseph Hume proposed to spend the national money in bringing over the obelisk, and contended that the money would be well spent for such an object. The cost of bringing over the obelisk has been estimated in years gone by at £100,000, but Mr. Dixon said he was confident that the cost would not exceed one-eighth or one-tenth of that sum. Eventually the British Government had renounced the gift. Recently, as was well known, Dr. Erasmus Wilson, F. R. S., had magnificently come forward and had offered to find the money if Mr. Dixon would undertake the engineering details involved in the transport of the obelisk to England. That offer had been accepted. The Kedhive, on being spoken to on the subject by Mr. Fowler, his Highness's chief engineer, and who was now in Egypt, said he should be pleased to see the obelisk removed to England if the Government would accept it on behalf of the nation. This the government has consented to do, and it has again been presented to England through our Consul-General in Egypt. Nothing now remains, therefore, but to remove the obelisk to England.—John Dixon, C. E., *in Van Nostrand's Engineering Magazine.*

DESICCATED EGGS.

It is already well understood that if albumen or white of egg be slowly dried in mass, or be dried rapidly at too high a temperature, a product or material will be the result which is of inferior and not uniform character or quality. Also, that if the yelk of eggs be dried in mass, slowly or rapidly, the result will be a material or product inferior in quality, not uniform in structure, difficult of solution, and of little value for the ordinary uses of the yelk of eggs. If batter of eggs composed of the whites and yelks together be dried in mass, the result lacks uniformity and solubility; and if either of these products, so obtained, be subsequently ground or pulverized, by any known process, the mealy result so obtained is of inferior quality, is slow of solution in water, and does not possess several of the important properties of the fresh shell eggs.

To meet this difficulty, the idea of the desiccation of eggs in rotation or agitation under the blasts of air, either heated or otherwise, has been variously applied during a long time past, both in this country and in Europe, but the difficulty mainly encountered has been that of producing a material capable of being preserved in different climates, of being readily and completely dissolved, and of being applied to the principal uses and purposes for which the egg may be applied before desiccation.

The natural egg contains, in varying proportions, a certain oil, hereinafter spoken of as the oil of the egg. This oil is a very important constituent of the egg. It is innocuous while in its natural condition—that is, in undisturbed combination with, or relation to, the other parts of the organism of the egg, its proportion thereto being relatively small.

When, however, this oil is set free by any process, it rapidly becomes rancid, highly offensive, and, in fact, acrid, and is a most potent and active agent in affecting the deterioration and decomposition of the other parts of the egg with which it may be brought in contact.

If, during the process of desiccation, the material to be desiccated is allowed to rise in temperature above a certain point, hereinafter indicated, the oil of the egg contained in the more solid parts, or which is not in suspension or emulsion, but is in more perfect combination with the other constituents of the egg, particularly that in the yelk, and so in the batter composed in the yelks and whites, is set free to a greater or less extent, according to the freshness and vitality of the eggs used and the degree of such heat. It has also been ascertained, by experiment, that the temperature at which this result follows varies at different times. The causes apparently depend upon barometric and other conditions of the atmosphere as well as the state of the thermometer. Such a result has usually followed whenever the material has been raised above 85° Fah. The highest temperature to which Mr. W. O. Stoddard, of New York city, who has made a special study of this subject, has been able to subject the material without that result following was 92° Fah.; but that was under exceptional atmospheric conditions, and he considers a much lower temperature than 85°, and, if possible, than 80°, very desirable for safety, and essential to commercial success in the manufacture. Indeed, his own operations have been conducted at a temperature not to exceed 80°.

Mr. Stoddard has lately patented (May 8, 1877) a device, the object of which is to regulate and control the temperature of the eggs, or parts of eggs, or batter of eggs, or other material during the process of desiccation, so as to prevent the development or freeing from the more solid part of such material of the oil of the egg not held in suspension or emulsion, being much the larger part of all the oil contained in the egg, and afterward to eliminate from the product derived such small portions of the oil of the egg as may have been held in suspension or emulsion, or may have been set free in the process of manufacture. The granulated or mealy product which is thus obtained will then, he claims, retain and protect its proper proportion of the oil of the egg, even if exposed to a much higher temperature than that above mentioned.

To obtain the object thus substantially set forth while employing for the process of desiccation a drying blast of warm air, he employs for the rotating surface, on which such desiccation is produced, a hollow cylinder, cone, frustrum of a cone, or other surface which may be artificially cooled by means of ventilation or evaporation in the interior while the material within is actively agitated.—*Scientific American.*

LIGHT-EMITTING FLOWERS.

The power of emitting light has been found to be possessed by several flowers. The daughter of the great Swedish naturalist, Linnæus, was wont to amuse herself in the summer twilight by setting fire to the inflammable atmosphere which surrounds the essential-oil glands of the *Fraxinella*. One sultry summer evening, when sitting in the garden, she was very much surprised to notice the flowers of a group of nasturtiums emitting luminous radiants, and she observed the same thing occur on several subsequent evenings in June and July, 1762. The same phenomena has also been observed by several naturalists, but almost exclusively in connection with yellow or orange-colored flowers, such as the sun flower, the marigold, poppies and the orange lily. The following account of interesting observations of some of these luminous flowers is given by Dr. Phipson: "The Swedish naturalist Prof. Haggern, perceived one evening a faint flash of light dart repeatedly from a marigold. Surprised at such an uncommon appearance, he resolved to examine it with attention, and, to be assured that it was no deception, he placed a man near him, with orders to make a signal when he observed the light. They both saw it constantly at the same moment, The light was most brilliant upon marigolds of an orange or flame color, but scarcely visible upon pale ones. The flash was frequently seen on the same flower two or three times in quick succession, but more commonly at intervals of several minutes. When several flowers, in the same place, emitted this light together, it could be seen at a considerable distance. This phenomenon was remarked in July and August at sunset, and for half an hour when the sky was clear; but after a rainy day, or when the air was loaded with vapors, nothing of it was to be seen. On the 18th of June, 1857, about 10 o'clock in the evening, M. Fries, the well-known Swedish botanist, while walking along in the Botanic Garden at Upsal, remarked a group of poppies (*Papaver orientale*), in which three or four flowers emitted little flashes of light. Forewarned as he was by a knowledge that such things had been observed by others, he could not help believing that he was suffering from an optical illusion. However, the flashes continued showing themselves, from time to time, during three-quarters of an hour. M. Fries was thus forced to believe that what he saw was real. The next day observing the same phenomenon to occur at about the same hour, he conducted to the place a person entirely ignorant that such a manifestation of light had ever been witnessed in the vegetable world, and, without relating anything concerning it, he brought his companion before the group of poppies. The latter observer was soon in raptures of astonishment and admiratiotion. Many other persons were then led to the spot, some of whom immediately remarked that the 'flowers were throwing out flames.' It is chiefly in the summer months that the emission of light from flowers is seen, and generally during twilight. It is said, however, that flashes have also been noticed in the morning, just before sunrise. The light emitted is always most brilliant before a thunder-storm." —*Leisure Hours.*

A MINE OF LIQUID SULPHUR.—In the vicinity of San Martino, near Palermo, Sicily, a mine of liquid sulphur is being worked; or, in other words, large collections of the substance are being made at points where it flows from fissures in the rocks, in quantities of from four hundred to five hundred weight per day. The sulphur comes from a burning mine within the mountain; and, in order to give it time to cool, so as to admit of gathering it, the outlets are frequently closed for brief periods. Quite recently on opening one of these closed fissures, it was found that the sulphur had disappeared; and, in order to renew the flow, it was suggested to tunnel down toward the mine. Hardly was the work begun, however, before the pressure in the rear of the obstructing mass became too great for the latter to withstand, and a terrific explosion ensued, hurling the workmen into the air, killing five and wounding badly six more.

Diamond Hunting in Georgia—Col. Lowman and Dr. Stephenson are washing for diamonds and rubies near the city, and have no doubt of success. Col. Lowman is practically acquainted with the workings of the Brazilian mines, and Dr. Stephenson is known to most of our people as an experienced miner and mineralogist. They are opening several veins of asbestos, and soon expect to open a corundum fissure, as the gold washings below the hill yield several pounds weekly of superior corundum, which justifies the belief that they will find the ruby and sapphire, all of which are chemically the same pure alumina. The specimens we saw are splendid. They also are finding elegant garnets and kyanites.—*Gainesville* (*Ga.*) *News.*

A remarkable example of rapidity in deep boring has lately been furnished by the first bore hole put down by a company formed to search for coal in Switzerland. A depth of 1,422 feet was reached in two months, including the reboring of the upper 640 feet from 3½ inches to 7 inches in diameter. The work was done, including all delays, at the rate of over 1,000 feet per month, the highest speed being nearly 77 feet in 24 hours. The results obtained were negative, the section showing about 1,200 feet of Permian strata resting upon old crystalline rocks; but the trial is only the first of a series.

A substitute for gunpowder, invented in England, is called "powder paper." It is paper impregnated with a mixture of potassic chlorate, nitrate, prussiate and chromate, powdered wood charcoal, and a little starch. It leaves no greasy residue on the gun, produces less smoke and less recoil, and is less impaired by humidity, and it is 5-16ths stronger than gunpowder.

EDITORIAL NOTES.

THE KANSAS CITY ACADEMY OF SCIENCE.

The society met at their rooms, 718 Main street, June 26th, President R. T. Van Horn in the chair. Minutes of last meeting read and approved. Rev. James G. Roberts, treasurer, made the following report:

	Dr.
To balance May 21, 1876	$71 50
To fees and dues May 31, 1876, to May 31, 1877	26 00
	$97 50
1876,	Cr.
October 15, by cash book	$ 1 00
October 30, by specimen case	5 30
1877.	
Feb. 2, by postage, expressage, etc	6 00
By exploration of mounds	10 00
June 26, by cash on hand	74 60
	$97 50

Judge West moved that a committee of three be appointed to raise money for library and cabinet purposes. Committee—Messrs. West, Parker and Winner.

On motion, Prof. Parker was instructed to ascertain if the Kansas Academy of Science would hold the next semi-annual meeting of their society in Kansas City.

Dr. T. J. Eaton was appointed to read a paper at the September meeting.

Dr. Halley then read a carefully prepared paper on "Heat as a Remedial Agent," which appears in this number of tne *Review*.

Col. Van Horn thought that the Academy ought to continue their explorations of the mounds, and make their investigations as complete as possible.

On account of the the absence of many teachers and members of the society from the city during the heated term, the academy resolved to adjourn until the last Tuesday in September.

On July 18th there arrived at the Union Depot one of the most distinguished scientific exploring parties that has ever passed West It consisted of Prof. Hayden, chief of the United States geological survey; Col. James Stevenson, of Washington; Prof. Joseph Leidy, of the University of Pennsylvania; Prof. Asa Gray, of Harvard University, and other distinguished scientists of the United States. They were accompanied by Dr. Joseph D. Hooker, President of the Royal Society of London, director ot the new botanical gardens, etc., and Lieut. Gen. Strachey, of the Royal Bengal Engineers, and a member of the council for India. These gentlemen some time since made arrangements, through friends in Washington and elsewhere, for a tour of scientific research this summer in Colorado, Utah and California, in company with the above distinguished Americans. The result of the tour will be communicated on the part of our countrymen, to the government at Washington, in the shape of reports.

Gen. Strachey has been for many years a prominent member of the Royal Geographical Society, and is now President of the geographical section of the British association for the advancement of science. He is author of several books of travel, and has a world-wide reputation as a geoprapher. Mrs. Hooker and Mrs. Stachey accompanied their husbands. The former was the widow of Sir William Jordan, an eminent naturalist, and Mrs. Stachey is the daughter of Sir J. R. Grant, formerly governor of Bengal, and at a later period governor of Jamaica.

At the depot the party was met by Judge West and Dr. Fee, of the Kansas City Academy of Science, who exhibited to them a number of relics found in the mounds of Clay county. They were highly pleased with them, and spoke in warm terms of the energy displayed by Kansas City in establishing a museum, and prosecuting local scientific researches. The party only remained about thirty minutes, and then proceeded west to Denver. The results of this extended scientific tour, which has been thus arranged, will, it is believed, be of great interest and value, and these will be attained entirely at the private expense of the distinguished gentlemen who compose the expedition. —*Kansas City Journal of Commerce.*

The local committee appointed to make arrangements for the twenty-sixth annual meeting of the American Association for the Advancement of Science, to be held at Nashville, Tennessee, August 19, has issued a circular, expressing the determination to spare no efforts to make this the largest and most interesting assemblage in the history of the Association. They expect to be able to furnish private entertainment to every member of the Association willing to accept it, to secure for those who prefer it hotel accommodations at reduced rates, and to arrange with the railroads for the issue of free return tickets, as also to provide for such excursions in the vicinity as will render the meeting both pleasant and profitable. The secretary of the local committee is Professor J. Berrien Lindsley, and Professor N. T. Lupton is chairman of the committee on receptions, either of whom may be addressed at Nashville, for particulars.

The invitation of Captain Howgate to the merchants of the large cities of the United States to assist pecuniarily tn his polar expedition has been responded to very liberally. The contributions have been so generous that he has been able to procure the vessel necessary (the Florence) and she will sail on the 20th of this month from New London, where she is now being fitted out for her voyage. The officer to command her is Captain Tyson, of the merchant marine. He was navigator of the Polaris, and been on several polar expeditions. The Florence is manned mainly by Connecticut sailors. She may stop at Frobisher's straits upon her course, but her headquarters will be on Cumberland, where a stock of supplies will be collected, and a score of Esquimaux with dogs and sledges will be enlisted for the expedition. If Congress grants an appropriation for the Howgate colony, annther vessel will sail from New York about July 4, 1878, and join Captain Tyson at Disco about August 5. Then they will strike north. Captain Tyson recently stated that he expected to stay in the frigid regions until he found the North Pole.

Besides the complimentary notices which the *Review* has received from prominent Eastern papers, such as Popnlar Science Monthly, the American Naturalist, Harper's Weekly and New Remedies, we are highly gratified with the flattering reception it has received from the press of Missouri and Kansas: The Leavenworth Times, Kansas Farmer, Osage City Free Press, Chetopa Advance, Miami Republican, Kansas City Journal of Commerce, Kansas City Times, Post and Tribune, Price Current, Church Guide, Richmond Conservator, the St. Joseph Herald, the Western Dispatch, Caldwell Sentinel, The Jewel, Fireside Guard, Brookfield Gazette and Columbia Statesman have all greeted it warmly, besides several others of which we have heard.

BOOK NOTICES.

THE ANNUAL RECORD OF SCIENCE AND INDUSTRY, 1876, 839 pp., octavo, Edited by Prof. Spencer F. Baird, and published by Harper Brothers, N. Y. For sale by MATT FOSTER & Co., $2.00,

As we stated in the June number of the *Review* this is the best of the whole series which Prof. Baird has been editing for the past six years. The general summary of the progress of science and industry during the year 1876, occupies two hundred and thirty pages, and each general subject has been written up by an eminent specialist. Such an array of learned and talented writers is rarely brought together in one book, and their connection with it, alone, assures exhaustive research and the utmost accuracy of statement.

The remainder of the book, 609 pages, is principally devoted to abstracts of important and valuable papers on special topics, and to brief digests of the more important and useful points in each. Every branch of science is fully treated, and more information can be gained from this Record concerning the current history of these branches than from any other single volume in existence. Nothing equal to it is published in the world, and not only is it adapted to the astronomer, geologist and chemist, but to the farmer, the artisan and even the housekeeper. This is shown by the chapters on Agriculture, Domestic and Household Economy and Technology, comprising ninety pages, which contain information and instruction of the most definite and reliable character, based upon and deduced from the experiments and researches of distinguished scholars in all countries in regard to such familiar topics as Manures, food for animals, noxious insects: Construction of buildings, lightning, heating and ventilation, clothing, the laundry and the table: Printing and engraving, moulding and casting, cleaning and bleaching, painting, staining and varnishing, plating, cementing and the utilizing of waste products. It is really worth more, directly, to the masses of the people than to scientists, because the latter are supposed to have more ready access to standard works and the special periodicals of their respective branches, while the latter are necessarily more dependent upon compilations and books of reference.

A Practical Treatise on Lightning Protection, by Henry W. Spang, with illustrations, 180 pp., Ramsen & Haffelfinger, Philadelphia, Pa.

This is a practical treatise on electricity and its properties and phenomena, with plain common sense remarks upon lightning conductors, founded upon observation and well-known facts. The intention and object of the author are to show that lightning rods in common use are insufficient, and for the most part constructed on false principles, and to point out how many of the materials used in the construction of our buildings, such as water-pipes, metal roofs and rain pipes, may be utilized as safe and sufficient conductors. The chapters on protection of buildings, oil tanks, steam boilers, ships, wooden bridges, telegraph poles, are eminently practical, and may be read with advantage by all classes of people. The author is connected with telegraphing, and writes from an extensive acquaintance with the subject of electricity in all its economic bearings, and not in the interest of any "patent lightning-rod."

The Elements of Agricultural Geology, by Wm. K. Kedzie, M. S., of the Kansas State Agricultural College. Wilson, Hinkle & Co., Cincinnati and New York. 96 pp.

This little work, prepared for the use of the schools of Kansas, reflects great credit upon its well known author, not so much for its profundity as for the skill which he has displayed in making it just what it is intended for—a manual for use in the schools. The trouble with most school books on the higher branches of learning is that they are too erudite, and that the learner fails to draw useful and practical inferences from them. He studies the text books, but at the close of his course, has no idea whatever of applying what he has learned to the ordinary pursuits of life. This will not be the case with those who use Prof. Kedzie's book. Every page has its practical teachings, and the youth of Kansas are to be congratulated upon having so valuable a text-book upon so important a subject.

Hours with Men and Books, by William Matthews, LL. D. Chicago: S. C. Griggs & Co., 1877. 384 pp. $2.00.

Professor Matthews has reached the top round of the ladder as a brilliant and graceful essayist, and his works are read with all the interest ever felt in those of Hazlitt or De-Quincy himself. His versatility is equal to his brilliancy, and he writes *currente calamo* on all subjects. His treatise on "Words: their Use and Abuse," obtained a wide circulation, and received the commendations of the most careful critics in the country.

The present work has already passed to a third edition, which is at least an indication that the author's popularity is still on the increase. The mechanical work of the publishers is a model of excellence in paper, print and binding.

Popular Science Monthly, August 1877, Appleton & Co., N. Y., pp. 128, $5.00 per annum.

With this number a change takes place in the editorial department by the association of Prof. W. J. Youmans with the former distinguished editor, Prof. E. L. Youmans, who has so ably managed this indispensable journal for the past five years. If doubling the editorial force shall have the effect to increase in the same proportion its usefulness and popularity, the American reading public will be fortunate indeed. The present number presents an unusually rich and varied table of contents.

Van Nostrand's Eclectic Engineering Magazine, July 1877, pp. 96, Van Nostrand & Co., New York, $5.00 per annum.

We are much gratified to number this valuable journal among our exchanges, and can safely promise those of our readers, who are interested in engineering and its kindred topics, frequent selections from its pages, which will amply repay them for the trouble of reading. This is a magazine which must be of the greatest interest to all engineers and mathematicians, being made up as it is from all the best scientific journals of the world devoted to these specialties.

New Remedies, Monthly, pp. 32, Wm. Wood & Co., New York, $1.50

This is a monthly journal of materia medica, pharmacy and therapeutics, and is ably edited by Dr. Fred. A. Castle and Charles Rice.

Sixth Annual Report of the Kansas City Public Schools, 1876–77. 100 pp. Ramsey, Millett & Hudson, Kansas City, Mo.

The public schools of Kansas City are justly an object of pride to all good citizens, having kept pace with its progress in everything else, and being, unlike some of our public institutions, substantial and excellent, in fact as nearly perfect as good officers and teachers can make them.

We learn from the President's report that more than $8,000 of the floating debt has been paid off within the past year; that the financial condition of the district has steadily improved; that a handsome library has been established, and that the past year has been the most satisfactory and successful year, so far as the workings of the school system are concerned, since its introduction. A high and well-deserved compliment is paid Professor Greenwood and the teachers under his charge, and the report closes with thanks to the community for its unanimity in encouraging and supporting the Board of Education at all times.

Among our most valued exchanges are the *Scientific American* and *Boston Journal of Chemistry*, both of which have at least a national reputation as the best publications of their class and to both of which we are indebted for some of our most interesting selections at different times.

The rapidly succeeding numbers of Dr. Hayden's Bulletins of the Geological and Geographical Survey of the Territories, filled with important scientific material, already constitute a very extensive library of scientific monographs.

PUBLICATIONS RECEIVED.

[*The receipt of all new publications delivered at the editorial rooms of this Journal will be acknowledged in its earliest subsequent issue. Publishers will confer a favor by promptly advising us of any omission in this respect. Accompanying memoranda of prices are desirable in all cases.*]

Annual Record of Science and Industry, Harper Bros., ...	$2 00
Lightning Protection, Claxton, Ramsen, & Hafflefinger, ...	1 50
Agricultural Geology, Wilson, Hinkle & Co., ...	1 00
Hours with Men and Books, S. C. Griggs & Co., ...	2 00
Ethnography of Hidatsa Indians, Secretary of Interior, ...	
List of Elevations, Secretary of Interior,	
History of American Bison, Secretary of Interior, ...	
Bulletins 7 and 9, National Museum, Secretary of Interior, ...	
Popular Science Monthly, July and Aug., Appleton & Co., ...	5 00
Popular Science Monthly Supplement, July, Appleton & Co, ...	3 00
Eclectic Engineering Magazine, July Van Nostrand, ...	5 00
Scientific American, July and August, Munn & Co., ...	3 20
New Remedies, July, Wm. Wood & Co,	1 50
Boston Journal of Chemistry, July, Billings & Clapp, ...	1 00
Mines, Metals, Arts and R. R Journal, July, C. E. Ware & Co., ...	2 00
London Journal Applied Science, P. L. Simmons, ...	4s.
Western Agriculturist, Quincy, Ills., July, ...	1 10
Sixth Annual Report of the Kansas City Public Schools, 1876–77.	
Telegraph Journal, London, Haughton & Co., ...	4s.
Monthly Weather Review, June, Signal Office, Washington, ...	
Phrenological Journal and Science of Health, August, 1877, N. Y., . . .	3 00
Druggists' Circular and Chemical Gazette, L. V. Newton, M. D., . . .	1 60
Library Table, H. L. Hinton & Co, .	3 00
Kansas Farmer, J. K. Hudson, . . .	2 00

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

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MINERALOGY.

THE WYANDOTTE, KANSAS, GAS WELL.

(BY THE EDITOR.)

Natural combustible gas has been known in various countries from remote ages, and is believed by most observers to result from the decomposition of organic substances, though, in many instances, the sources of this gas have been found to be in geological formations below the coal strata, and especially are such gases frequently found in salt wells and mines.

The most celebrated natural fountains of gas are located in the tertiary formations of the rocky peninsula on which the Russian city of Bachu, on the shores of the Caspian Sea, is built. Through these strata large quantities of naptha and petroleum issue, while volumes of inflammable gas are constantly evolved, giving to the locality the name of the "Field of fire." In the Szlatina salt mine (Hungary) illuminating gas issues at a depth of 90 metres below bank from a marly clay, which is interspersed between the layers of rock salt. This has been known since 1770, and the gas is now collected and used for lighting up the mine. In the province of Szu Tchhouan, China, illuminating gas issues from borings made for rock salt, and is conveyed in bamboo tubes to the furnaces, where it is used for lighting purposes and evaporating the brine. Similar phenomena are described as existing at Arbela, in Central Asia, and at Chittagong, in Bengal.

In the Western Hemisphere such phenomena are by no means rare. In Nova Scotia, for instance, in one of the coal mines, at a depth of 180 feet, a volume of water was suddenly thrown forth with the greatest violence. "The whole mine appeared to be thrown in a state of regular mineral fermentation. The gas roared as the miner struck the coal with his pick; it would go off like the report of a pistol, and at times it would burst pieces of coal off the solid wall. Though no particular exhibition of gas was seen at the surface before the coal was reached in the shaft. the river over its line of out-crop was suddenly thrown into a state of violent ebullition, and the gas could be inflamed upon the surface of the water. It also collected in holes dug in the river bank, and being fired, would burn for months, unless extinguished.

Similar gas bursts have been experienced at salt wells in New York, Pennsylvania, Ohio, Virginia, and elsewhere in the United States, and in several instances the escaping gas has been utilized for illuminating towns, heating dwellings, boiling salt water and heating blast furnaces.

The gas well at Wyandotte, Kansas, described below, is located about one mile above that city, and not more than three miles in a direct line from the court house in this city. Upon visiting it last week we were so unfortunate as to find the occupant of the premises away from home, and no one who could give any definite information regarding it. We were, however, shown into the house and there found it burning in the cooking stove, and saw it lighted up as for illuminating purposes. It burns freely without perceptible odor and gives a clear, soft, light of about three-fourths the power of our ordinary manufactured gas. Tests made by competent experts show that there is no sulphur or carbonic acid present in it, and that, in all respects, it is exceptionally pure. The water has a strong saline taste and contains, apparently, a large proportion of carbonate of iron. Professor T. J. Eaton, of this city, will shortly make an analysis of both gas and water, when we shall be able to give the exact facts. The writer of the subjoined report, Mr. N. McAlpine, is an old citizen of Wyandotte, a close observer and a most reliable gentleman. He has taken a deep interest in this gas well, and the statements made by him may be relied upon implicitly. There can be no question as to the value of this discovery to the people of this vicinity, and we confidently expect that this gas will speedily be utilized, both for domestic illuminating and heating purposes, as well as in the various manufacturing establishments in Kansas City, Wyandotte, Rosedale and Armstrong.

WYANDOTTE, KANSAS, August 9, 1877.

Theo. S. Case, Esq., Editor Western Review:

While reading an account of the Iola gas well and analysis of its mineral water, in the last number of your valuable publication, it occurred to the writer that you would, perhaps, deem worthy of an insertion in the REVIEW a description of the natural gas well (almost at your door) in Wyandotte City.

This gas well was discovered by a company prospecting for coal, about three years ago. After boring a five inch hole to the depth of four hundred feet, the operator reported the drill as having passed through a twenty-eight inch vein of bituminous coal. Just then the workman at the drill was astonished to hear a bubbling, rumbling sound, roaring like distant thunder. It was the gas freeing itself from confinement below, and forcing ahead of it a large body of salt water, as high as the top of the derrick drenching the driller completely. Ever since then the pressure of the gas continues to force the water in jets to the surface. This mineral water, although never advertised, is very much used, with good effect by invalids, both near and far, and the gas (carburetted-hydrogen) has been escaping into the atmosphere, 75,000 feet daily, or enough to light a very large city, ever since.

In Pittsburg, Pennsylvania, three of the largest rolling mills for the manufacture of iron have been supplied, for the past three years, with natural gas exclusively for light and fuel; the gas being conveyed in a seven inch pipe from one well in the oil regions, a distance of twenty-one miles.

This Wyandotte gas is used by the Company in the furnace for raising steam, and by the owner of the farm where the well is located for cooking and light. The gas, whether flowing or burning, is almost odorless. Its entire freedom from sulphur renders it highly adapted for the reduction of silver and gold ores. Sometime ago the Kansas City press advocated the policy of capitalists forming a company for the purpose of reducing at this railroad centre, Rocky Mountain ores, as is done at the works at Omaha. To monied men who contemplate embarking in such an enterprise, it will be information to know there is a hydrogen gas belt in this vicinity.

Notwithstanding a coal vein of sufficient thickness to pay was discovered, the company has concluded to abandon coal mining for the present, with its attendant heavy cost for elevating coal from a deep shaft, and utilize this new gas fuel which rises from the depths to the surface of the earth of its own accord and with pressure enough to force itself in any direction desired.

It is not only suitable for heating purposes, but is very valuable for light; it burns with a clear bright flame without purification, and is free from the disagreeable odor accompanying coal gas.

It is similar to the gas used for so many years to light Fredonia, N. Y., and other towns located in the oil regions of Pennsylvania. Scientific men who have visited this well give as their opinion that the gas is produced by the distillation from coal shale and other minerals by the internal heat of the earth, and that the supply is inexhaustible.

The company, after obtaining the exclusive right to light Wyandotte and Kansas City, Kas., for the term of 20 years, built a tank and gas holder having a capacity of 40,000 cubic feet daily. Recently they have enlisted some of your Kansas City capitalists in their favor, who will furnish the gas mains for the purpose of conveying the gas to light said towns, and ultimately

Kansas City, Mo. No company manufacturing gas from coal can compete long with one supplied by Nature with gas free of charge.

Some parties who have collected statistics from the gas producing regions of New York, Pennsylvania and Virginia, contend that this natural gas business is capable of being developed to an unlimited extent, and we predict that in the near future the people of Kansas City will be furnished in their houses with this light, clean, new fuel, free from dirt, smoke and ashes.

Below find statement of thickness of each stratum passed through, as reported to us by the man in charge of the drilling:

	FEET.
Soil	12
Blue limestone	1
Clay Shale	7
White limestone	13
Bituminous shale	3
White limestone	10
Shale	2
Limestone	9
Grey fossil rock	3
Clay shale	16
Black flint	4
Shale	6
Limestone	19
Shale	5
Limestone	13
Shale	3
Limestone	2
Shale	3
Limestone	7
Clay shale	57
Sandstone	24
Red shale	2
Sand rock	6
Streaks of shale, sand and soapstone	20
Clear soapstone	12
Lime and soapstone	16
Red shale	8
Conglomerate	8
Sand and clay	14
Blue clay shale	9
Dark conglomerate	5
Limestone	7
Coal, (some gas here)	inches, 16
Light clay	" 4
Clay shale, alternate hard streaks	52
Magnesian limestone	30
Bituminous shale	4
(Here tremendous flow of gas and salt water.)	
Good bituminous coal	2
Clay, slate and sand	16
(Here much salt water.)	
Sandstone	75
Coal	inches, 6
Hard limestone	4 ft. 6 in.
Shale	25
Hard fossil rock	2
Coal	1
Very hard limestone	3
Shale	14
Hard limestone	2
Coal	inches, 32
Fire clay	1
Red clay or mineral paint	2
Hard limestone fossil	6
Bituminous shale	10

The amount of water forced up by the gas will fill a pipe $1\frac{1}{2}$ inches in diameter, running constantly.

The illuminating quality of the gas was tested by Dr. Woodward's photometer, and as it comes from the well it is equal to twelve-candle power. At a small cost it can be purified so as to make it sixteen-candle power.

The water, I believe, has been analyzed by Dr. Eaton. The brine is not strong enough to justify the manufacture of salt. It is presumed a stronger vein of brine may be had by deeper boring. The water is highly recommended by invalids, who have used it for its medicinal properties. It seems to contain a large per centage of iron. It also acts as an easy aperient, and performs several other cures too numerous to mention.

This company comtemplate an extensive mineral bath establishment, with hot, cold and swimming baths. Very respectfully yours,

N. McAlpin.

MECHANICS AND ENGINEERING.

TORPEDO WARFARE.

COMPILED BY THE EDITOR.

The magnitude to which this once universally contemned system of naval warfare has attained recently, renders it important to the general reader that the whole subject be condensed into a single article, which has been attempted in this chapter.

The earliest submarine machine for blowing up ships, of which we can find any account, was invented in 1776, by David Bushnell of Connecticut, who called it the torpedo or "American turtle," from its peculiar shape, and was designed to destroy the British shipping during the Revolutionary war. In 1805 Robert Fulton designed torpedoes on a somewhat similar plan, which were also employed for the destruction of British vessels during the war of 1812. In 1854 the Russians employed torpedoes in the Baltic Sea during the Crimean war, and during the American rebellion of 1861 they were frequently used on both sides.

Until a very recent period but two classes of torpedoes have been used, viz: Those self-explosive upon contact with the attacked vessel, and those dependent for exlposion upon an electric current supplied from the shore; and it may be added that until very recently their use has been followed by very meagre and unsatisfactory results.

The government of the United States, however, within a few years past, has devoted much time and expended large sums of money in improving and perfecting the topedo system, and since the outbreak of the war between Russia and Turkey the subject has received far more attention than ever before from all nations. The inventors of England and France in particular have expended a vast amount of ingenuity upon such machines. The result of all this is a development of submarine warfare to an extent which seems about to offset the value and importance which has hitherto been set upon immense guns and steel-plated armors for ships of war. Torpedoes have been contrived to meet pretty much all the requirements of naval warfare, and may be classed as follows: Harbor torpedoes, Spar torpedoes, Harvey (towing) torpedoes, Whitehead (fish) torpedoes and the Lay torpedo.

"The Harbor torpedo is a sort of sunken mine, exploding either by contact or electricity. If these are judiciously laid down around a harbor or anchorage, the approach of hostile ships will be rendered impracticable, provided always they are protected by shore batteries or armed ships to prevent removal. Every channel may be barred by these hidden mines, and they may be made so powerful that any ship under which they explode is sure to become hopelessly disabled. They are fastened to and held in their positions by anchors or stockades. The bursting charge consists of gunpowder, gun cotton or dynamite; and the case or shell is either made of iron or wood; in Charleston harbor, old steam boilers were frequently used."

"The Spar torpedo is fastened to the end of a spar from 15 to 38 feet long, and explodes also either by electricity or contact. A most remarkable experiment was recently made at Cherbourg, France, with spar torpedoes, carried by a little vessel called the Thorneycroft, which was almost submarine. A very small part of it was above water, but it was of sufficient strength to carry engines and two lateen sails, and it was worked by a lieutenant, two engineers and a pilot. The French Admiral had two disabled ships in succession towed out to sea at a speed of 14 knots an hour. The Thorneycroft, however, was able to go at the rate of 19 knots an hour, a rate not attained by any vessel in the squadron. She very soon caught up with her prey, delivered her blow with a Spar torpedo, which projected from her bow and rebounded. A rent as big as a house was made in the side of the ship attacked and she sank at once."

"The Italian government has already carried out this idea in the construction of her formidable new ironclads, Dandolo and Duilio. The vessels are fitted in their sterns with sort of armored dry dock, harboring a small torpedo steamer. As soon as the services of the latter are required, the dry dock is filled with water and opened and the little craft rushes out at the enemy, returning to her safe berth after her mission has been fulfilled."

"The Harvey (towing) topedo was invented by an English officer in 1862; it was soon adopted by nearly all the other navies, and probably will be exclusively used in general actions at sea as least liable to injure a friendly vessel in the melee, The Harvey torpedo is towed upon the surface of the water by a wire rope towline from a derrick end of the yard arm over or against the enemy; and just before reaching the ship to be destroyed this towline is slackened, and the torpedo, being heavier than water, dives under it. When in this position the explosion is effected by means of a mechanical firing bolt striking down upon a pin as soon as certain levers of the torpedo come into contact with the bottom of the target, This torpedo can also be made to explode by electricity. Two different forms are used for starboard and port."

"Whitehead (fish) torpedoes. This invention is the secret and property of the British Admiralty, but the following details have leaked out: These torpedoes resemble in shape a cigar, pointed at both ends, and are 18 feet long by two feet in diameter. The inside is divided into three different compartments: First, the head, which contains a charge of 350 pounds of gun cotton and the pistol or detonator to explode it; secondly, the balance chamber, which contains a contrivance for setting it so as to remain at any depth at which it is wished to travel under the water line; and lastly, the air chamber which contains the engines and the compressed air to drive them. The after end supports the screws—a right and left handed—which propel the torpedo and are made of the finest steel. The air chamber is tested to the pressure of 1,200 pounds on the square inch, although for service it is only loaded to 800 pounds. The Whitehead torpedo can be made to go at the rate of 20 knots for 1,000 yards, and at any depth that is desired, from one foot to 30 feet. It can be set to explode either on striking an object or at any particular distance under 1,000 yards—in artillery language, either by a percussion or a time fuse. It can also be set so that if it misses the object aimed at, it will go to the bottom and explode at half cock or come to the top on half cock so as to be recovered, as it has buoyancy enough just to float on the surface of the water when not in motion. It is fired from what is called an impulse tube, which, out of a frame fitted to the port, discharges the torpedo into the water. It can be fired above the water, but will at once go to the depth it is set for, and then go straight to the object, no matter how fast the ship from which it is discharged is going, or how fast the object aimed at may be sailing or steaming."

"Properly speaking, the Lay torpedo, the invention of Mr. Lay, purchased by the United States government, is not a torpedo, but a very ingeniously devised submarine torpedo boat fitted with a spar torpedo. This boat has the advantage of not requiring any crew on board, but in other particulars is capable of great improvements. The motive power consists of an engine driven by carbonic acic gas and a screw propeller. The boat is entirely submerged, and is steered and in other respects controlled by means of an electric battery on shore connected with her by a cable which is coiled up in her hold and pays out as she moves away. Her location is indicated above the surface of the water by a flag, so as to enable the operator to direct her course. The greatest defect of the Lay torpedo is the want of speed. The United States government stipulated for a speed of nine statute miles per hour, but the maximum speed actually attained at the late trial trip, when it was steered by Lieutenant R. B. Bradford, U. S. N., showed only an average of 6.60 miles per hour, so that a ship attacked would only have to lower her boats and let them row between the approaching torpedo and the shore, and cut the cable, which would leave the torpedo at their mercy."

The English papers notice the invention by Rev. Mr. Ramus of a new torpedo called a "rocket float," propelled at the rate of 275 miles per hour, for a distance of four miles, on the surface of the water. The apparatus is described as a timber or iron vessel, the bottom of which is a series of inclined planes. In the head is the explosive, and enough gun cotton can be carried to blow up the largest iron-clad in existence, while the rocket, by the combustion of which the craft is impelled, is laid along the deck. The vessel is guided by a rudder of thin sheet metal.

The torpedo steamer "Alarm," designed and constructed under the supervision of Admiral David D. Porter, of our own navy, is probably the most destructive, as well invulnerable, craft of the kind afloat. She is also an excellent and most buoyant sea boat, admirably arranged for the comfort and convenience of her crew and officers. She is 172 feet long, including a ram or beak

32 feet long. She is steel-clad and is so constructed as to have really two hulls one outside and so far separated from the inner one that a person can pass from one end to the other between them. In addition to her terrible ram, she carries two spar torpedoes. We copy from the *Scientific American* a brief description of her action in a naval fight:

"Having sighted an enemy—say at night—her compound engines drive her headlong at him at the rate of 15 knots per hour. As she nears him, the immense electric light on her bow flashes out its glare, blinding her adversary to her own hull (which is already sunk so low that her deck is but three feet above the sea), while displaying his every proportion. The roar of her 15-inch gun, as it hurls its huge shot or shell into the attacked vessel, is followed by the crash of the bow spar torpedo striking the devoted craft thirteen feet below the water line. Then, perhaps after a momentary check due to the torpedo recoil, the Alarm plunges forward, driving her immense ram into her adversary's crushed side. As she swings broadside on to her foe, another torpedo spar shoots out from her side, and another torpedo is exploded under the unguarded bottom of the enemy; while the machine guns on the torpedo boat's rail keep up a deadly fire of thousands of bullets per minute, sweeping her opponent's decks."

The Russians have adopted a system of small steam launches, steered by electricity, or by a man or two on board, who are protected by a bow screen and bulk-heads. These launches can be run directly under the side of a large vessel, under cover of smoke or darkness, and deal destruction to an enemy before their approach is observed, or even if observed, they are too small to be readily hit by a shot from the ship.

Among the defences proposed for vessels of war against torpedoes, are wire or rope netting, or screens, suspended to booms overhanging the vessel's sides, an electric light which shall dazzle the eyes of the seamen managing the torpedo boats, smoke clouds from the burning of smoke balls to conceal the whereabouts of the ship, and finally, the entire change of construction of naval vessels from iron-clads, which are so easily sunken and are so costly and unwieldy, to vessels constructed almost solidly of wood, so that they cannot be sunk, and yet are lighter and more readily handled than those at present in use.

METALLURGY.

THE MONNIER PROCESS OF REDUCING REFRACTORY ORES.

Mr. J. W. Wright has lately investigated this process at the Providence Mine, near Nevada City, and makes the following report to the *Mining and Scientific Press:*

This valuable mine is owned by Messrs. Walraths and Hunter. During the last six months they have been preparing for the introduction on this coast of this new method of reducing ores, and for more than a week past their works have been in successful operation. This is the method of reducing refractory ores by roasting and lixiviation, as invented and patented by Alfred Monnier.

Being kindly afforded every facility to investigate this method of extracting the precious metals so entirely new to our coast, I shall try, by aid of the Professor's explanations, and the accompanying diagram I have made of the ground plan of the works, to give your readers some idea what this method is, how it differs from, and what its advantages are over the usual method.

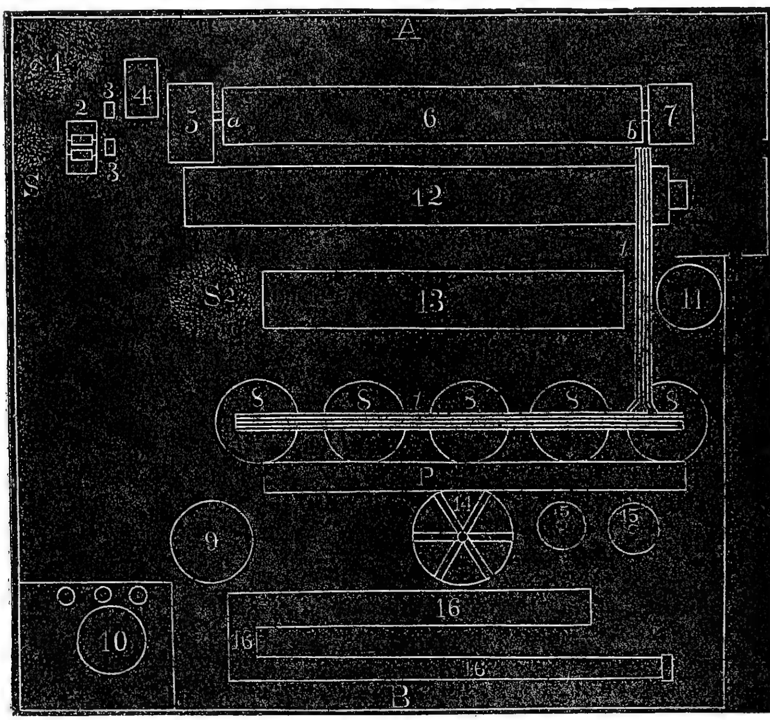
These works are on a steep hillside. Going from A, the highest point, to B, the lowest, you descend from floor to floor some 20 feet. The shaft and hoisting works are about 100 feet to left of point 1. The order of arrangement of cylinder, tanks, arastras, etc., will naturally vary according to the surface to be built upon.

1. Lump ore from mine. S. Sulphate of Soda. 2. Rock-breaker and crusher. 3. Elevators which carry crushed ore and soda to 4, receptacle of same, whence, through 5, they are conducted into 6, revolving cylinder, where the mixture is roasted. 7. Fire-box of cylinder. 8. Lixiviating tanks. 9. Reservoir for lixiviating tanks. 10. Reservoir for strong solution. 11. Feeder for evaporator. 12. Evaporator. 13. Crystallizing tank. 14. Arastras. 15. Feeder for copper-plate in 16, amalgamating trough. P. Roasted and lixiviating ore ready for arastras. S2. Sulphate of soda taken from crystallizing tank. *b*, point where iron car receives roasted ore. *t*, tramway over which car passes to lixiviators.

What are known among miners as "refractory ores," are those containing a large proportion of metallic sulphurets. The method long in vogue in what are called the "sulphuret works" of our mining regions, is that of *chlorination*, where common salt, manganese, and sulphuric acid are used, and must be purchased for that purpose. The Monnier method for the treatment of metallic sulphurets may be correctly distinguished from the former as the method of *sulphatization*—a term suggested by Prof. Monnier—since its chemical processes consist in changing into sulphates the sulphurets of different metals contained in the quartzose ore.

The Messrs. Walraths and Hunter have been working their mine about six years, reducing the ore by the common method of chlorination. Their shaft is down something more than 800 feet, with the usual drifts every 100 feet. Some twenty men are now at work in the different drifts, and the ore brought up daily is a very fine quality of sulphurets. The chemical compounds it contains, besides the pure silica of the quartz, are sulphurets of silver, copper, iron, zinc and lead, containing gold, also small quantities of arsenic and antimony. That portion of the ore which is reduced by the Monnier method is treated as follows:

The crude dry ore in lumps (1) is mixed with sulphate of soda (5) and passed by the shovelful into the rock-breaker and thence between Cornish rollers (2). The proportion of the mixture is 20 lbs. soda to 80 lbs. ore. Through one elevator (3) the crushed mixture passes to a wire sieve with 24 holes to the linear inch, *i. e.*, 576 to the square inch. From this sieve the coarser particles return by a chute to the rock-breaker, the finer pass through it into a second elevator (3), which conducts the finely pulverized and dry material into a large box (4), whence it is passed regularly through a small chamber of brick and iron into the huge revolving iron cylinder (6), which is five feet in diameter by 40 long.



Ground Plan of Providence Reduction Works.

The roasting is here accomplished. This cylinder is revolved very slowly by water power. Its upper end (*a*) is raised six inches above the level of the lower end (*b*). This elevation can be increased, according to the proportion of the sulphur in the ore. The cylinder has now been revolving without intermission for a month. Its slow motion causes the roasting mixture to gravitate gradually towards the lowest level, and some 12 hours are required for the crushed sulphates to pass from the upper to the lower end of this revolving cylinder. It thus contains at one time about seven and one-half tons of the ore, since about 15 tons are reduced by this method every 24 hours.

An intensely heated draft of air passes steadily from the fire-box (7) into the lower end of the cylinder. The mixture is thus heated to a high degree, until at the lower end (*b*) the ore reaches a dark red heat. This roasting within the cylinder gradually transforms the sulphurets into sulphates and the gold is set free. Chemically this is explained by the sulphur becoming oxidized and forming sulphuric acid. This combines with the soda, forming a bisulphate of soda, the decomposition of which reduces successfully the sulphurets of iron, etc. A considerable quantity of sulphurous acid is also formed and escapes from the cylinder. The resulting sulphates being soluble in water, you can look with safety from the upper end of the cylinder through its entire length, and see myriads of brilliant scintillations flying to and fro, and falling like so many meteors in miniature. These are caused by the union of sulphur with the oxygen from the atmospheric air. The degree of heat required is maintained by consuming in the fire-box half a cord of mountain cedar each 24 hours. The red hot ore passes at *b* into an iron wheelbarrow, which is trundled by one man along tramway (*t*), passing over five huge wooden tanks (8), made on the Monnier plan, and partly filled with water at its natural temperature. Here the process of lixiviation begins. The man who handles the wheelbarrow takes the roasted ore from it by the shovelful and drops it into any one of the lixiviating tanks. Quite a detonation follows as each shovelful is thrown in. This is continued until each tank receives its allowance.

By a set of rubber tubes connection is kept up between the liquid in three of the tanks at a time, thus forming a battery.

When the water in any of the five tanks holds in solution the largest possible amounts of sulphates of silver, copper and soda, it is sent by a tube into small tanks filled with cement copper by which the silver is precipitated. Thence the remaining liquid is run into a reservoir (10). This is done in what is called the silver room.

Any weaker solution is passed into another reservoir (10), to be used again in lixiviating till it attains sufficient strength.

From the reservoir (10) the solution is conducted by a wooden pump and trough into a tank under tank 11. Thence it is raised by a wooden pump into the latter tank, which serves as a feeder (11) for the evaporator. This huge evaporator is filled through a wooden trough from tank 11, and the liquid in it is kept at boiling heat by the hot air passed into it from the revolving cylinder and the fire-box.

After a certain time allowed for evaporation the remaining liquid is passed by rubber syphons from the evaporator into the crystallizing tank (13). This tank now contains only sulphates of copper and soda in solution. As the liquid cools, the sulphate of soda crystallizes, and is drawn out by an iron hoe with a long handle into a pile (*s*2), to be used over again to repeat the process *ad infinitum.* The amount lost is scarcely appreciable.

The copper in solution is then precipitated by iron. All the round tanks are about the same size, having a capacity of some 700 cubic feet. The five used for lixiviating each holds 25 tons of ore, besides the water needed to dissolve the sulphates of silver, copper and soda.

We will now return and see what becomes of the residue of insoluble matter left in the lixiviating tank. It consists of silica, pure gold and sesquioxide of iron, also a small amount of silver with sulphate of lead. When the liquid has been drained from it, it is shoveled out on the platform (P), from which it is passed into the surface (14). After mixing with water and thorough grinding it runs into the feeders (15)—which act also as reducers of the remaining sulphate of silver—and thence through wooden spigots and troughs into the broad, shallow and long troughs (16), provided from point to point with boxes or catchers of peculiar construction. The bottoms of these boxes and troughs are covered with amalgamated copper plates. Here the gold is so free it is immediately taken up by the quicksilver and with the remaining silver is secured in the form of an amalgam, while the residuum, containing oxide of iron, passes outside of the building to a large wooden tank. From that the oxide is collected in a still larger tank, where it settles, and is collected and dried. Mixed with oil this oxide of iron makes the purest of metallic paints—its natural color reddish brown—and is the very best that can be used on all iron structures. By combining different ingredients with it various colors can be produced. It makes a first-class fireproof roof paint.

We shall close this description by stating some advantages of sulphatization over chlorination, as is proved at the Providence mine.

By chlorination much of the coarse gold may be lost, and no silver can be saved. Sulphatization usually saves from 92 per cent. to 95 per cent. of the gold, and leaves it in such a free state that quicksilver takes it up at once.

To chlorinate gold some 48 hours are generally required. The method of sulphatization requires but 12 hours. Chlorination extracts gold only. This "Monnier method" extracts gold, silver, copper and oxide of iron. Then these better results are obtained at a greater reduction of expense in labor and fuel, and the expense of buying sulphuric acid, manganese and salt is avoided. It takes one man at the roasting cylinder in the Monnier process, and half a cord of wood, in twelve hours, to sulphatize fifteen tons of ore, when by other processes, such as chlorination, it takes three men and one cord and a quarter of wood for one ton and a quarter of ore.

The only material purchased in sulphatizing is sulphate of soda at a trifling expense, while the method produces its own sulphuric acid. As has been shown, the soda can be used again and again with scarcely any loss.

When we remember how rich in sulphurets are the almost exhaustless quartz leads of our mountains, we can scarcely overestimate the value of this successful introduction of Prof. Monnier's method on the Pacific coast.

The Professor informs me that the application of the revolving cylinder in this method is new and far surpasses expectation. As to the other apparatus, it has been brought step by step to its present state of perfection by its use in the Eastern States in the treatment of 14,000 or 15,000 tons of sulphuret ores.

METEOROLOGY.

The Importance of a General System of Simultaneous Observations of Atmospheric Electricity.

BY W. E. AYRTON AND JOHN PERRY,

Professors in the Imperial College of Engineering, Tokio, Japan.

The great practical value of simultaneous meteorological observations is the assistance they afford us in enabling fairly accurate predictions of the weather to be made some hours in advance.

But all these observations are derived from instruments like the barometer, thermometer, etc., which are only affected by the air or other bodies in their immediate neighborhood· A disturbance produced in the higher regions of the atmosphere cannot possibly affect the barometer or thermometer until this wave of disturbance has traveled down to the lower air strata, whereas electrical and magnetic instruments are instantaneously sensitive to disturbances produced at great distances: the pneumatic despatch and the electric telewraph may, in their difference of speeds, be taken as fairly analogous with the sluggish barometer and ever-watchful electrometer.

Dr. Veeder has drawn attention forcibly to the fact that even surface winds, although they affect the weather, produce no change in the barometer.

Now, since the value of all storm warnings increases with the time by which they precede the danger, the day may come when electrical and magnetic observations may not only aid, but actually supplant barometric observations.

Mr. Cromwell Varley, the well-known electrician, having noticed that on several occasions earth currents were followed by a change of weather, communicated this fact to Admiral Fitzroy, who found such information so much assistance to him in predicting the coming of storms, that he requested to have it regularly supplied. "On some occasions," says Mr. Varley, "Admiral Fitzroy could see the approach of a storm days before the barometer indicated anything of the kind."

Our present knowledge of this subject may be summed up nearly in the words of Sir William Thomson in his address as president to the Society of Telegraph Engineers. Suppose for a moment that there were no electricity whatever in the air—that the air was absolutely devoid of all electric manifestation, and that a charge of electricity were given to the whole earth.

Well, now, if space were non-conducting—and experience on the vacuum tubes seem rather to support the possibility of that being the correct view —if all space were non-conducting, our atmosphere being a non-conductor, and the rarer and rarer air above us being a non-conductor, and the so-called vacuous space, or the interplanetary space beyond that (which we cannot admit to be really vacuous), being a non-conductor also, then a charge could be given to the earth as a whole, if there were the other body to come and go away again, just as a charge would be given to a pith-ball electrified in the air of this room. Then, I say, all the phenomena brought to light by atmospheric electrometers, which we observe on a fine day, would be observed just as they are. The ordinary observations on atmospheric electricity are precisely the same as if the the earth were electrified negatively, and the air had no electricity in it whatever. In rainy weather, however, the potential of the atmosphere referred to that of the earth is sometimes positive and sometimes negative.

Observations made everywhere in the northern hemisphere tend to show that the potential is greater in summer than in winter, but the months of maxima and minima appear to differ at different places. Observations made at Kew and Windsor in Nova Scotia show distinctly two maxima in the year, those at Brussels and Kreuznach only one. Both the Kew and Brussels observations show two maxima daily, at 8 a. m. and 10 p. m. in July, at 10 a. m. and 7 p. m. in January, and at about 9 a. m. and 9 p. m. in spring and autumn. Although, therefore, all the tests made at different parts of the earth's surface in fair weather (except some of doubtful meaning made at the peak of Teneriffe in the early days of the study of this question) have shown the earth's surface to be negatively electrified, the amounts of electricity existing at the same time at different places will be very different; and this difference manifests itself in a manner often extremely disagreeable to the telegraph engineer—in natural line currents.

The country in which these natural line currents have been most carefully studied is undoubtedly British India, since the uniform system of land line testing employed in the Government Telegraphs throughout that country causes the accurate measurement of these currents to be daily carried out. From the results of 10,000 such measurements it is seen that in India the direction of the current is far more constant than its magnitude, and on the whole there appears to be a marked preponderance of currents of positive electricity flowing from the East to the West—that is, with the sun; and such a current the laws of electro-magnetism tell us would be consistent with the earth's magnetism.

Observations made on the Atlantic cables tend to show that when there are no unusual disturbances the earth currents at one end have two positive maxima and two negative maxima daily. Submarine cables, however, even when long, are far less disturbed by terrestrial currents than land lines, which may possibly be due to the sea having a far greater electric conductivity than the land.

Since the early days of telegraphy a large number of observations of natural currents have been made at the principal London Office in Telegraph street, the results of which were communicated to the Astronomer-Royal.

These tests seemed to show that natural currents in land lines were the continuations of the submarine currents which were arrested by the comparative non-conductivity of the land, for on Mr. Varley's endeavouring to find the neutral, or equi-potential, line for the currents of the east coast of England, he found it to coincide approximately with the shore line.

During auroras these currents become extremely strong, sometimes as great as can be produced by the employment of a battery of 2000 of Daniell's cells, and occasionally even exceeding this. Of such currents the most extensive set of simultaneous observations that have been made was during the remarkable aurora of February 4, 1872; but as on that occasion these observations were not the result of any general system of measurement, but owed their origin to the fact that the currents became so strong as to interfere with the working of all the telegraph lines throughout the world, it cannot be expected that any large amount of information can be derived from the mass of records made on that day. One point however can be learnt from these observations, and that is this—first, the general direction of the positive currents was from East to West, that is, with the sun; secondly, along lines running North and South the currents were comparatively weak.

There seems to be no doubt now that the earthquakes are preceded, or accompanied, by unusual strong natural currents in telegraph lines. As far as we are aware, attention was first drawn to this by one of the writers of this paper in a communication made to the Asiatic Society of Bengal, in June, 1871, in connection with the Indian earthquake of February 16, of that year. The Indian earthquake again of December 15, 1872, preceded by such strong earth currents during the evening of December 14th in the land lines from Valentia to London, that in order to send messages it was necessary to loop the lines, by means of which the current in the one line was made to neutralize that in the other. The Egyptian earthquake of January 12, 1873, was preceded for some days by equally strong natural currents. This earthquake was also accompanied by an eruption of the volcano Shaptar Jokull in Iceland, which lasted from January 9 to January 12, and it is interesting to notice, as Mr. Graves, of the Atlantic Cable Co., has pointed out, that a direct line drawn from Cairo to Iceland crosses the telegraph wires from Valentia to London. Again, the Italian earthquake of March 17, 1875, was accompanied by great disturbances on the land lines of Italy.

From what has preceded, it may be concluded with a fair amount of certainty, that (1) atmosphere electricity, (2) auroras, (3) earthquakes, (4) magnetic distances, (5) natural currents in telegraph lines, (6) sun spots, and (7) wind storms, are all linked together, and we feel that if this is shown, nothing more is needed to induce thinking people to interest themselves in the subject of this paper.

As regards the method of measuring the atmospheric potential, we have not much to add. Sir Wm. Thomson's quadrant electrometer, combined with his water-dropping collector, forms a very delicate measuring apparatus for observatories, and can easily be made self-recording; his probable electrometer and burning match may be used instead by travelers, or when neither very delicate observations nor automatic records can be taken.—*Abstract from Proceeding of the Asiatic Society of Japan—London Telegraphic Journal.*

PALÆONTOLOGY.

REPORT OF DISCOVERY OF MASTODON TUSK.

BY H. H. WEST.

Absorbed alone in the present, amid the busy scenes of life, we little dream of the silent past until accident has revealed, hidden perhaps at our very feet, some strange monument, some mysterious vestige of a long bygone age, to recall its reality. An accident of this kind has thrown in our way a relic of the largest of the extinct terrestrial mammals, and recalls to our minds the wonderful life of the Post-glacial time.

Last June I found on Campbell street, about one hundred and fifty feet north of Independence avenue, a fragment of the tusk of the mastodon It was at the bottom of one of those deep channels, caused by the natural drainage, so characteristic of the loess, imbedded in the upper part of the drift. The piece secured is only two and one-half feet in length, with a diameter of four and one-half inches at the larger end, and two inches at the smaller, but the tusk was traced for a distance of five and one-half feet, and was probably considerably longer, as the base and apex are both wanting. It was so badly decomposed that it was saved with difficulty. Small fragments were found scattered through the clay and gravel for several inches around it, evidently broken and scaled off at the time it was deposited.

The following section will better show its geological position :

Buff loess loam..10 to 15 feet.

Gravelly bed—gravel consisting of chert and argillaceous shale ....6 inches.

Sandy loam, sparingly interspersed with fragments of chert and shale.. ....5 feet.

Gravelly bed, with limestone fragments, containing *productus longispinus*, *terebratula bovidens* and a small trilobite. This gravel is probably all derived from the rocks in the immediate vicinity,.......................................6 inches.

Sandy loam, penetrated by many vermicular tubes and and small pockets filled with black and greenish material. The lower 8 inches contains drift pebbles...............2 ft. 6 in.

Sandy clay, with pebbles and boulders of granite, greenstone, quartzite, kidney-ore (spathic iron), quartz, etc.......1 foot.

In this bed the tusk was found. Several feet of obsoletely stratified drift sand, with pebbles and boulders are found in the gully below this.

CHEMISTRY.

THE MATERIAL RESOURCES OF LIFE.*

BY ALBERT B. PRESCOTT.

To be able to live, in any way known to us, it is indispensable to have a body. And, as living bodies come by growth and continue by nourishment, it is first necessary to have materials whereof bodies can be made—and renewed and kept in warmth and strength. Just these materials, with the permission of the reader, we will try to take account of, as resources of life. Life is not maintained "by bread alone;" other needful resources being known to physical science, and still other resources greater than all being recognized by their results in life; but we have the bread alone, as enough, certainly, to be considered in the present article.

Living things are in very deed made of "the dust of the earth;" but it is by no means all of the dust of the earth that serves this purpose. We have to distinguish between substances out of which organized instruments of life can be made, and a much larger number of substances never used in the making of these instruments.

We have it in mind that matter is made up of sixty-three simples. At all events, the earth's crust and air are constituted, substantially, of these sixty-three sorts of atoms, and, as a good many of the same are already revealed in the sun and stars by the spectroscope, it is likely that they are the chief elements in the universe of matter. Of the sixty-three, certain elements, found only in very small quantities, appear to be of subordinate importance in that part of the universe under our immediate observation, whatever purposes they may fulfill in other earths or in the centre of our own, or at other epochs. Others of the elements bear an important part in the structure of the globe or in the uses of mankind, but are not organizable materials, and they are not in our present consideration. Of the sixty-three, only fourteen or fifteen simples, about one-fourth of those known to us, are used in the construction of plants and animals. These, then, are before us, as the elemental resources of life.

It will be understood that the tissues are not built directly of these fourteen elements, but of their chemical compounds. Each one of these compounds is a definite substance in external character distinct from its

*An address given before the Detroit Scientific Association, December 13, 1876.

constituents, as, in a familiar example, water is distinct from the hydrogen and oxygen of which it is composed. The number of these chemical compounds built into living tissues is very great, a number uncounted. It is of these compound substances—of their molecules—that the cells are builded; builded by an action very unlike chemical action and into shapes very unlike chemical results. Also, it is by the consumption of these compounds of the fourteen elements that animal warmth and activity are sustained. But, not turning aside here to question the chemistry (the making of molecules) going on in cells, or the vital organization (the building together of molecules) going on in cells, not once lifting our eyes toward any of the dynamical sources of life, we bend our attention to find out, if we can, the raw material for cells, the inorganic resources of the organic world.

It is the organic world together, to be sure, that is able to subsist on the fourteen elements as these are given by the earth, the animal kingdom obtaining most of its material at second hand, as elaborated by the vegetable. The two kingdoms are, in the end, mutually dependent on each other in gaining sustenance from the earth's supplies.

The fourteen indispensable simples may be classified, in different ways for different ends. There is a privilege of provisional classification, for the sake of comparison and of acquaintance; and, with the promise not to impose our arrangement upon any other occasion, we would like, for the purpose of our present quest, to divide the elemental resources of life into two categories, as follows: 1. Those supplied so abundantly on the earth that all individuals share them alike, without favor of fortune or forethought of mind. We may name them redundant resources. 2. Those provided so sparingly that individuals do not share them alike, but secure them by effort and by opportunity. They may be termed adequate resources.

From the provision of the first class of materials, it results that, in certain great essentials of organization, all individuals are placed on a footing of equality with their fellows. It results from the provision of the second class of materials, that unequal qualities and quantities of organization are derived by different individuals of the same species. Through our redundant resources we are taught the common brotherhood of the created. Through our adequate resources come the assurances of our responsibility—our commissions as stewards of the earth. Materials given in a superabundance that cannot be wasted constitute a dispensation of mercy; its benefits falling alike on the just and on the unjust, the lazy and the diligent, the foolish and the prudent. Materials given in a competence that must be guarded constitute a dispensation of compensation; inciting to exertion, rewarding for attainment, and training the powers of volition. By the first, the democracy of equal privileges and inalienable possessions is maintained; by the second, the aristocracy of merit is preserved.

The redundant resources so abound that they can have no value, in the sense of exchangeable value, in society; even though needed as they are in more constant supply than those of the other class. The resources which are barely adequate are those which come to be objects of personal possession; they are the things of which mine and thine are declared, and it is because of them that title-deeds are drawn and prices-current established. The substrata of poverty and of riches rest in the chemical elements.

With the definition of each class in mind, let us now consider the supply of some of the more important of the elemental resources. From the fourteen, let us take at least three elements of each class, as representatives. For the redundant resources, we will take carbon, oxygen and hydrogen. Then for the adequate resources, we will examine nitrogen, phosphorus and potassium.

Carbon is the one element never left out of a organic compound. Its atoms are not only constituents, they are corner-stones of all the organic molecules. In the human body, thirteen parts in a hundred, or forty per cent. of the solids, are carbon. Looking for its supply, we see that it is obtained for the organic world by the plants, and from the carbonic-acid gas of the air. It is taken from the air chiefly by the leaf of the plant. How much carbon is taken from the organic mould of the soil and from acid carbonates, through the roots, is perhaps not fully settled; but we are well assured that the main and sure resource of the plant for this element is the air. The supply, then, is as abundant and impartial as the open air itself. The carbon material forms but a small part of the air, it is true, only about five parts in 10,000; nevertheless, it is enough, at least for the average rate of vegetable nutrition. Carried around the globe in the viewless air to every plant alike, the carbon-atoms are supplied for the framework of every cell in plant and animal. A dwarfed shrub or rootless lichen, clinging to the crevices of a naked rock on a frigid shore, has at hand a good supply of the same resource that is furnished to a luxuriant palm spreading from a tropic soil.

And the carbon-supply in the air is not a reservoir diminishing, however slowly, from age to age; but, to be sure, it is a returning fountain, replenished from the exhalations of animals and the decomposing remains of all organized bodies. In Nature's economy, the same carbon-atoms are used over and over again as material for organization. This perpetual replenishment, a thrifty provision against future exhaustion, is one not peculiar to carbon, but it is a provision made in good degree for every one of the elemental resources of life, whether redundant or only adequate in its immediate supply.

That plants feed upon the carbonic acid of the air is known to the school children, and has been known to men for a hundred and one years at least. Priestley, whose discoveries were celebrated in the chemical centennial at Northumberland, Pennsylvania, two years ago, placed it on record very clearly that "air vitiated by animal respiration is a pabulum to vegetable life." This was but the next year after Priestley's discovery of oxygen itself; yet to this day there lingers in our common thought an undefined impression that the carbonic acid of the air is just an impurity, tolerated because there is only a little of it, but an impurity that it were as well to be rid of altogether. Now, if the redundant resources of life were at our human disposal, we might be in danger, some day, in the sheer forgetfulness of self-regard, of throwing away as an impurity the very foundations of sustenance. Some one, perhaps, would set forth that this gas when not diluted is immediately fatal to human life; another would declare, "Once a poison, alway a poison;" and another would ask why we should imperil our own health for the sake of the plants.

Oxygen was named next, among the primary resources, redundant in supply. It is a prominent constituent of all living tissues, forming seventy-two parts in a hundred of the human body with its fluids. It is taken in two conditions: first, in combination, chiefly by the plants; second, in the elemental state, by animals. In combination, it is taken by the plants from carbonic acid gas, just noticed as a source of carbon; from water, to be considered as a source of hydrogen; and, in smaller quantities, from a considerable number of other substances. The greater part of the oxygen in animal tissues is obtained in the products elaborated by the plants.

But for all animal life the most imperative demand is for oxygen in the elemental state.

The other elemental resources are available only in their compounds; oxygen does its best service when alone. The others serve life as materials for its bodily tissues; oxygen has an additional duty, the maintenance of operations giving warmth and strength. The activities of life consume various materials, but most constantly of all they demand a raw material of inorganic nature, a simple material in its primitive condition. This supply of elemental oxygen, a necessity for all animal life, is a necessity that is imminent in direct proportion to vital activity, and for man is absolutely imperative. When supplied with oxygen, we can subsist days without other food; when deprived of oxygen, life fails in a few minutes. It is scarcely a figure of speech to say that the breath is the life. The energy of oxygenation is told in every stroke of the heart. The food that is eaten does not raise an iota of bodily strength without the help of the pound and a quarter of pure oxygen that is daily inhaled. To breathe poorly is to faint; to eat richly and breathe poorly is to suffocate and perish.

The supply of elemental oxygen is certainly impartial and bountiful without reservation. It is more than given—it is pressed upon us; to escape from it is a work of toil and difficulty. No one is poor from want of it, or rich from gain of it. Were it furnished for pay, all that a man hath would he give for an hour's supply of it. The poor, taken together, fare best in its use; while the wealthy, in their elaborate contrivances to exclude the cold and wet and wind and glare of the weather, can make but slight impediments to its distribution.

One other element we were to inquire of, among the redundant materials: the unit of chemical measures, hydrogen. As light as it is, it makes over nine weights in a hundred of the body of man. It is obtained chiefly by the plants; mostly from water, but to some extent from ammonia, the the latter being more notable as a source of another element.

Water is not quite always as free as air—failing the needs of the stationary bodies of plants more often than it does the wants of animals, and in the quantities taken as food by man hardly liable to a notable value in exchange. As a substance not wholly gaseous, it is not easy to conceive how water could be more abundantly supplied than it is, without being a burden and a hindrance to life. It is doubtful whether mankind would vote for any uniform increase in the quantity of water on the planet. If water was supplied in vapor more abundantly than it is, by having a lower vaporizing point, the conditions of all life would be changed—the atmosphere would be put out of its adjustment with the organic creations.

Some of the simpler forms of life subsist almost wholly upon the three elemental materials we have had in consideration, with a few others of the plentiful resources; and living beings taken together use much larger quantities of these than of the substances more sparingly supplied. But, as to the relative importance of the two classes of resources, it can only be said that the higher forms of life can no more exist without the one than without the other.

Of the adequate resources, nitrogen is needed by the largest number of living bodies and used in the largest quantities. It enters into most animal tissues and the more complex of the vegetable products; being two and a half parts in a hundred of the body of man, or eight per cent. of all its solids. It is obtained for the organic world solely by the plants, and obtained only from combinations of nitrogen, the ammonia and nitrates of the air and the soil.

The supply of this combined or available nitrogen in the air is limited —enough for a measure of vegetation, but not near enough for the greatest growth of food-plants and grains. The quantity of combined nitrogen carried by the rain from the air to the plant roots was found to be, in the rainfall of a year in Great Britain, equal to seven pounds of ammonia on an acre; another year it equaled nine and a half pounds per acre. The constituents of wheat are such that twenty-four bushels require the nitrogen of forty-five pounds of ammonia; that is, for the crop on a given surface, about five times as much as the rain furnishes. Plants doubtless gather directly from the nitrogen compounds of the air without help of the rain, and obtain a larger supply from the organic mould of good soils; but that all these sources together provide hardly enough is pretty clearly proved by feeding the roots of the plants with additional nitrogen compounds. On all but the richest soils, the suitable application of ammonia or nitrates causes a notable increase in the quantity of food-plants, and also causes an increased proportion of the nitrogenous constituents of plants. If nitrogen compounds could be laid down cheaply enough, it would augment the supplies of food and raiment, and the comfort of man, in no small degree.

Right here it comes to mind that uncombined nitrogen forms over three-fourths of the weight of the air—a provision of about eleven pounds on every horizontal square inch—and a question rises, "Why cannot the vital forces take hold on the pure element and use freely from its most lavish supply?" Well, because the universe exists. The stomach does not digest the carbon of charcoal; nor do the lungs take oxygen from water. To propose any alteration in the character of one of the sixty-three elements is to undertake the reconstruction of the universe. It is the character of nitrogen to refuse chemical combinations. Uncombined nitrogen is nowhere available for vital uses, to any appreciable extent. Filling perfectly its humble service in Nature as a diluent in the air, its qualification is to be inert and to remain changeless. Among the resources of life and in the marts of subsistence where its compounds rank high in value, nitrogen as a simple has no place at all.

This barrier between nitrogen and its compounds seems to hold firm from age to age. Out of the ocean of atmospheric nitrogen the plant selects the scattering molecules of nitrogen compounds and elaborates therefrom many nitrogenous substances. The animal elaborates some of these into other compounds. But in the final decay of products and tissues, and food not assimilated, the nitrogen of all returns again to ammonia—again in the aërial ocean, and again the resource of plants. If ammonia is oxidized in the air to nitric acid, the latter is deoxidized in the soil to nitrous acid and then to ammonia. All these compounds are very frail, and change most constantly, but together they hold the little stock of united nitrogen, losing little of it and gaining little for it, from epoch to epoch.

There are leakages, to and fro through this remarkable barrier, it is true, but they are so small that little is known of them, except that they show the strength of the barrier that limits them. On the one side, there is a little loss, by the liberation of traces of nitrogen in its certain organic decompositions. Also, the explosive agents used by man in warfare and the arts result in the liberation of nitrogen—an expenditure of life-resources. On the other side, by the electrical disturbances of the atmosphere, traces of nitrogen are brought into union. The roll of thunder indicates the restoration of a modicum of that good material which was wasted for the roll of artillery. Again, it is believed that in organic decay under restricted conditions some measure of nitrogen is brought into union with nascent hydrogen

Chemical art has not done anything toward the appropriation of this obstinate element. Nothing nitrogenous can be made of nitrogen. The manufacturers depend on gatherings from the sparingly distributed nitrates of the earth. As machinists have dreamed of perpetual motion, sleeping chemists may dream of an invention to bring atmospheric nitrogen into use, that all the barren places may be made fertile, and the whole earth flourish as a garden of fatness. But for this dream to realize the proportions of a fair probability it is quite essential that chemistry should be well asleep.

The chief commodities bearing nitrogen are nitre or saltpetre (potassium or sodium nitrate) and ammonia. In Hindostan, the rich soil-mould, warm and alkaline, becomes thinly crusted with nitrate, which is gathered and brought to market as East India nitre. Gunpowder, gun-cotton and nitro-glycerine, as well as chemical products, are made with it. In the war of 1812, America was thrown upon her own sources for gunpowder material, and enough nitre was found in the cave deposits of the Southwestern States. Then France was hemmed in by hostile armies, and had neither nitre nor cave-deposits, but it was after the work of "Lavoisier of Immortal Memory," and the government put trust in chemistry. Berthollet and the rest soon justified the trust in the perfection of the "nitre plantations"—beds of farm-refuse with wood-ashes exposed to the air.

These products, soil-nitre and compost nitre, and the ammonia obtained as a by-product in the manufacture of illuminating gas, serve their several purposes in the arts and applications of man, but their limited quantities do not warrant their addition to the soil for the increased growth of food. Now, unlike these common supplies, the earth possesses a special resource for nitrogen in combination, anomalous in being fully mineralized and remarkable in being both concentrated and extensive, a chain of mines full of nitre. On the Pacific coast of South America, extending from the fourth to the fortieth degree of south latitude, about 2,400 miles along the slope of the Andes to the sea, in Bolivia, Peru, and part of Chili, there has been found a line of deposits of sodium nitrate, the "Peruvian nitre." The beds are of variable thickness, covered by one to ten yards' depth of earth and half-formed sandstone. The dry soil of most of this rainless country is pervaded, in some degree, with this deposit. The mummied remains of the old Peruvian people are embalmed with it by the earth in which they were buried; and its crystals glisten on those ghastly relics which were presented in the Peruvian department of the Centennial Exhibition, and those brought to this country by Dr. Steere. It has been estimated that in the province of Tarapaca, within fifty leagues square, the quantity of the nitre is not less than 63,000,000 tons. The appropriation of this vast resource has been taken up rather slowly, but has much increased for ten or twelve years past. Vessels laden with it go to the coasts of manufacturing countries. At Glasgow the works devoted to the production of ordinary saltpetre from the nitre of Peru extend over acres of ground. In 1868, 100,000,000 pounds were used in Great Britain. As yet, it has been applied to the nourishment of crops only to a limited extent. But this seems to be its chief destination, and for this use it lies in the earth, a vast mine of wealth, for the disposal of coming generations. When multiplied population puts the sustaining of the earth really to the test, this fund of sustenance on the Peruvian coast must come to outweigh in value the gold and silver mines of the California coast.

Of the several nitrogen compounds which nourish plants, ammonia yields the most immediately satisfactory results. And of this fertilizing material, some wellnigh mineralized deposits must be counted in with the earth's possessions. To take note of these ammoniacal materials, we have again to begin at Peru. Standing on the shores which front the nitre-beds, and looking west upon the Pacific, there are seen, we are told, the low patches of the Cincha Islands—islands which shine with the whiteness of a powdery covering, a loose deposit of considerable depth. A cargo of this substance was first taken to London in 1840, stored and advertised for sale, and after a while thrown into the Thames. A second cargo was tried as a fertilizer by an English farmer, and found to give such marvelous results that the shipping company made good haste to contract with the Peruvian government for the entire deposit. This article, well known as guano, has held a settled value ever since its introduction, and, had it come into the hands of the alchemists, it would, very likely, have been presented as an elixir of vegetable life. Now, its worth is graded by analysis, and is indicated chiefly by the proportion of ammonia it contains.

The absence of rain will account, perhaps correctly, for the unusual retention of the soluble material characteristic of the guano of Peru; but the formation of the nitre-beds of that region is a problem in geological chemistry more difficult to determine. There are evidences of volcanic overflow and marine deposition, and the alkali in the compound may have originated in either of these or other sources, but neither the volcano nor the sea could furnish the nitrogen of the compound. If not from organic accumulations, we seem to be referred to the air as the source of nitrogen, and left to conjecture the conditions and forces which could bring elemental nitrogen into union in so great a quantity. Without pursuing these inquiries, it may be permitted to cite a fact which seems entitled to consideration in the case, namely, the conditions for an unusual overflow of atmospheric ammonia in this region. It is fed by perpetual trade-winds—winds coming from the south-east across a wide continent of soil that is rich to rankness, and warmed under a vertical sun. Coming from the Atlantic and saturated with water, these winds gather the exhalations of a continent, and then, shedding their water on the Andes, leave their ammonia (it may be supposed) to find its way by some means to the valleys of the western slope.

Again, these same mountain-valleys of Peru may claim to have given the world still another token of unexampled sources of nourishment, in the growth of the cinchona-tree, bearing the richest stock of nitrogenous bases in the vegetable world. It seems, indeed, more than a coincidence that this narrow, rainless, wind-nurtured slope of land should send to all the earth three such eminent resources as Peruvian nitre, Peruvian guano, and Peruvian bark.

Another of the materials adequate for no more than the needs of life is phosphorus. This element so far differs from nitrogen that it is not found uncombined in Nature, and if separated by art it immediately enters into combination on exposure to the air. It occurs chiefly in phosphate of lime, taken from the mineral kingdom by plants and also by animals. The hard part of bone is about nine-tenths phosphate, and phosphorus is an element of molecules organized into muscle and nerve.

The proportion of phosphates in the crust of the earth below organic remains is very slight, insufficient for the support of the higher forms of vegetable or animal life. It has been concentrated and gathered into the soil by the selective agency of the organic world, as it continues to be concentrated from the soil by each individual plant, and from vegetable products by each individual animal. Nearly all the phosphorus accessible on the planet has been the constituent of living bodies. Its proportion in the soil is a main factor in the growth of cereal grains. Already, and with the stretch of land to the westward, bone-earth and phosphatic guanos are well known in American markets. When phosphates fail at the root of the plant, grain fails at the mill; and when, from waste at the mill, phosphates fail in the bread, the bones and the teeth fail in growing bodies. The improvidence that leaves excretory phosphates to be washed away to the salt sea, farther from the reach of life than they were in the primitive rocks, is an improvidence that prepares an inheritance of poverty for after-generations. And the ruthlessness that permits the purveyors of food to sift phosphates from the food of men does its part to enfeeble the present generation.

There remains to notice another representative of the adequate resources, potassium. The statements made as to the supply of phosphorus, with some reservation, become true for potassium. Certain of the rocks contain a proportion of it, but from insolubility this is slowly available, and is insufficient for the needs of higher organic life. The soils contain more, because the organic world has gleaned for the soil. Potassa and soda are two alkalies which replace each other in the laboratory at the convenience of the chemist, but, in the choosing of the living cell, one of these is always taken and the other left. We get potassa free from soda in the ash of a tree which grew in a soil having more soda than potassa. From sea-water, containing near 200 parts of soda to one of potassa, the sea-weeds furnish an ash having two to twenty times more potassa than soda. From the blood of man, having ten to fifteen times more soda than potassa, the muscles obtain a composition of six or seven times more potassa than soda.

This gleaning is good proof of the value of more, and the evidence is confirmed by the application of potassa as a fertilizer. The stock of potassa—which is used somewhat in she arts—is derived mainly from the gatherings of the organic world. The ash-wagon takes up the savings of the hearth. In France the washings of sheep's-wool are saved, and 160 pounds of good potassium carbonate are obtained from a ton of the wool. In the pioneer life of this country, the housewives have burned corn-cobs and taken the ash for baking-powder, eighty per cent. potassium carbonate, and preferable to the "dietetic saleratus" now used. Should the ash of the entire corn-crops of the United States be taken without loss, it is estimated that over 100,000,000 pounds of potassium carbonate would be obtained. In the salt-beds of Stassfurt, Germany, there is a good proportion of potassa, and the use of this supply has been steadily increasing, both as material in manufactures and as a fertilizer.

At the present time, the market value of the resources of life engages little general attention. There is a narrow branch of commerce, wherein the prices-current of the three elemental materials which we have taken as "adequate resources" are the values constantly under calculation in daily business. In this guild, one sells nitrogen at thirty cents, another offers phosphoric acid at five cents; and all parties have a tacit understanding that the values of nitrogen, phosphoric acid and potassa, are to each other about as six, one and a half, and one, and that these are the only values to be considered. The technical terms of any profession or pursuit are jargon to the general ear. But hearing a man say that he "sold a hundred tons of rectified Peruvian at thirty-one cents for nitrogen, this morning," it is not so much as understood to what sort of business such jargon belongs.

Thinking of the multiplication of life and the waste of its resources, it seems that, in the time coming, the phrases that tell the rise and fall of value in commercial fertilizers may find some general recognition—may even have as much meaning for everybody as the terms of the gold market and the silver stocks.

It is only about a hundred years since man began to attain such definite knowledge of the components of matter as enables him to trace (we by no means say to understand) the transmutations of earth and air into tissues fit for life. Thirty-six years ago, Liebig commenced giving the people the first really systematic lessons upon the material resources of life. Seeing the value of a knowledge that goes below the surface of things, in 1852 he wrote his conviction that, "ere long, a knowledge of the principal truth of chemistry will be expected in the political enonomist and statesman, as it already is held indispensable to the manufacturer and physician." And, seeing the meanings and mysteries that cluster around the primary forms of matter, he wrote at another time: "It is not the mere practical utility of these truths which is of importance. Their influence upon mental culture is most beneficial; and the views acquired by knowledge of them enable the mind to trace, in the phenomena of Nature, proofs of an infinite wisdom—for the unfathomable depths of which language has no expression."

HYGIENE.

ON CATARRH.

BY DUDLEY S. REYNOLDS, M. D.

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The term Catarrh is one that has been generally applied to all forms of acute inflammation of the membranous lining of the air passages. Prof. G. B. Wood, in his "Practice of Medicine; devotes the last chapter of the first volume to the consideration of the subject of Catarrh, and he defines it as being "any acute inflammation of any of the mucous membranes of the body, not due to traumatic causes." As we usually see Catarrh in practice, Catarrh affecting the lining of the nose, the upper part of the throat, the Eustachain tube, and the cavity of the tympanum, the cases in the earlier stages of the disease rarely present themselves for treatment, except in that class of persons who suffer from catarrhal inflammation invading the middle ear.

It is a well known fact that the majority of persons who suffer with impairment of the hearing are effected with Catarrh, afflicted with an inflammation which is usually due to the inhalation of poisoned air. It was very clearly, unmistakably and undoubtedly established by Schonbein, in 1851, in his experiments with electricity, that powerful currents of electricity passing through the air decompose the oxygen, and develop a substance called ozone, which is said to be an allotropic form of oxygen. Ozone was demonstrated by Schonbein to be possessed of power to irritate the air passages sufficiently to develop the inflammatory processes of varying degrees of intensity, in proportion to the amount of ozone in the air and the duration of time occupied in the inhalation. It was noted on divers occasions, by astronomers, that whenever powerful currents of electricity occur, along with sudden elevations of temperature, there is general complaint from epidemic influenza, which is just another name for Catarrh.

We all remember what was called the epizootic, which prevailed in the winter of 1873 und 1874. The epizootic was a kind of Catarrh or influenza which affected the inferior animals. It is precisely the same cause which produces naso-pharyngeal Catarrh as we find it in our daily practice. The simplest form of Catarrh is that in which there is an afflux of all the circulating fluids in the membranes, with augmented secretion. That gives rise, of course, to considerable swelling and consequent obstruction to breathing, and we find that, whereas the nasal passages were perfectly free a few moments ago, that we are obliged to open our mouths to breathe. If you examine a case of that sort of Catarrh, you will find there is a very slight increase in the general redness of the membrane, without the destruction of all its transparency, the blood vessels in the mucous membrane being clearly and distinctly visible, at the same time the venous trunks greatly distended and engorged. There is hyper-secretion of mucus, and along with this hyper-secretion of mucus is found, in many instances, an exudation of serum from the surface. There is a set of glands in the mucous membrane lining the nose known as acinous glands, which afford a secretion precisely identical in appearance and in chemical composition with tears. At the same time the lachrymal glands are irritated. There is a greatly increased secretion of tears, and when the Catarrh affects the nasal passages, extending up through the nasal duct into the lining of the eyelids, we have what is called coryza. That means acute Catarrh, affecting not only the nasal passages, but the conjunctival membrane as well.

We usually see cases of Catarrh that have existed for some time. They are not apt to present themselves for treatment until the disease has shown a disposition to linger, because Catarrh is one of those forms of disease that attack almost all animate nature. It attacks everybody that breathes air—every animal that breathes air is liable to acute Catarrh, and these attacks often disappear of themselves, without treatment.

Catarrhal inflammation, like any other localized inflammation, has a natural tendency to recover after running a definite course. But on account of the complicated character of the nasal passages, and the liability of the secretions to be retained in the ramifications, we find a steady disposition upon the part of this particular membrane or lining of the nose to suffer from chronic forms of disease—a special disposition upon the part of the catarrhal diseases to linger in the nasal passages. It sometimes fills the naso-pharyngeal space. It remains confined to that particular locality in many instances, for weeks, months, years, and from the naso-pharyngeal space it travels the Eustachian tube into the middle ear, and produces destructive changes in the wall of the tympanic cavity, before the presence of Catarrh is even suspected. With the aid of the rhinoscope, Catarrh limited to the naso-pharyngeal space may be discovered. The peculiar conditions of the membrane may be readily understood by bringing the surface directly into view. I say directly; I mean indirectly into view with the aid of the rhinoscope. In cases of Catarrh limited to the naso-pharyngeal space, attended with inflammation of the ear, it has been the customary practice to regard the disease as an affection of the ear, because the symptoms were not distressing until the hearing became impaired, and along with the beginning of this impairment in the hearing there was no pain in the ear. Pain, from what cause? From the swelling of the Eustachain tubes and limited supply of air in the tympanic cavity, and in that manner preventing the equal pressure of the air upon the drum membrane, giving rise to such tension as was sufficient to create great pain—great distress.

In some cases, where the quantity of air in the tympanic cavity from this source has been very limited, slight pressure upon the tragus forces the drum head backward, and the joint between the malleus and incus is dislocated. This is an exceedingly painful condition, but may, if taken in time, be relieved, simply by inflating the middle ear with air. As to the treatment of Catarrh, of course it would be impossible for anybody to exhaust the subject, or even approach exhaustion.

It is to the treatment of chronic catarrhal affections of the lining of the nose, throat and ear, that we propose to confine our remarks this evening. Cases attended with hyper-secretion of mucus, partial loss of smell, dryness of the throat, the unpleasant sensation, if not positive pain, from attempts at swallowing, usually disclose upon inspection a double character of morbid change, a suppurative and proliferous inflammation, at the same time, in different parts of the same membrane; for instance, the lining of the inferior passages of the nose and the covering of the inferior turbinated bones yield an abundant secretion; perhaps the covering of the superior turbinated bones at the same time; but it frequently happens that the membrane covering the superior turbinated bones is perfectly dry, considerably swollen, very hard and indurated. At the same time the posterior wall of the naso-pharyngeal space presents the appearance of induration and dryness, and whatever mucus manages to flow over upon the surface of this membrane speedily dries in a hard, tough crust. It may be seen simply by making an inhalation with the mouth open; it may be seen upon the entire posterior naso-pharyngeal wall, down into the bucco-pharyngeal space. Cases of this kind are seen in every-day practice.

The greatest discrimination is necessary in the treatment of this double form of disease, the suppurative and proliferous form co-existing in different parts of the same membrane. In the first place, wherever the disposition is found to discharge tenacious substances, it becomes necessary to aid nature by some sort of medicament which has power to dissolve the fibrinous matter, and in that way facilitate its expulsion. For this salines, such as are usually employed as gargles, are serviceable, applied directly to the naso-pharyngeal space, with what is known as the posterior nasal syringe, which is a curved instrument having a bulbous point, with a great number of perforations in the bulbous tip. With the aid of this, any of the salines usually employed as gargles may be thrown into the naso-pharyngeal space, and in that way brought into contact with the largest portion of the membrane, and wash out the offensive matter. Now, if mucus accumulates in a crypt, if it is found in a cavity in any part of the body, it will rapidly degenerate into pus. The moment the requisite amount of moisture is withdrawn it dries. The dry quality is almost invariably due to the presence of pus. If it were not for pus, it would remain in the condition of ordinary mucus, and be expelled by being drawn up through the nose. Having cleansed the passages with a solution of bromide of potassium or muriate of ammonia—if the passage is very dry the bromide is not so good as the ammonia. Where these salts are not convenient, chloride of sodium may be used instead. It is not so good a defibrinizing agent, neither has it the power to stimulate secretion like the ammonia, nor has it the anæsthetic properties of bromide, yet it is a very good substitute in the absence of the other two salts. Of course all these these things are to be kept in view in prescribing for cases of Catarrh. I have taken this typical form of chronic Catarrh as it presents itself for treatment, for obvious reasons.

After cleansing the passages with the posterior nasal syringe, which is an invaluable instrument, any instrument which has power to atomize or reduce fluid to the finest possible state of division may be used, and in that way you can medicate the whole of the nasal passages. Any instrument which has that power may be used for the purpose of medicating the naso-pharyngeal space and the little crypts in the nasal passages. I am in the habit of using, in preference to other instruments, what is known as "Holmes' Boston Perfumer." It has a metallic tip, and if properly cleansed, will not get out of order for a long time. It is the most serviceable instrument that I know of for the purpose of medicating the passage after cleansing with the posterior nasal syringe. A solution of the bromide of potassium, as a general thing, is the best, say from ten to forty grains of the salt to an ounce of water, and in proportion to the strength of the solution, the interval should be great; if the forty-grain solution be preferred, it should not be used more frequently than twice in one day—once in twelve hours. If the weaker solution be preferred—and that should depend upon the quantity of secretion—if the secretion is going on rapidly, if there is a large amount of matter secreted, the weaker solution applied frequently is the preferable method.

Now, after the disease has lasted some time, and the discharge somewhat dried up, as it were, leaving still an inflamed surface—preter-naturally dry, without any disposition to throw off its secretion—a solution of iodine and glycerine answers the purpose best. That is to be used, also, with the atomizer; to be preceded by the posterior nasal syringe loaded with some sort of cleansing fluid, to remove any of the inflammatory matters collected in any of the crypts or cavities of the nasal passages, or any where in the naso-pharyngeal space.

By the use of the speculum, introduced into the interior nares, and a strong light reflected from a concave mirror, the nasal fossæ may be explored, except in those cases where there is great swelling in the covering of the superior turbinated bones. It is precisely in this locality that catarrhs are likely to linger, and likely, always, to escape observation; and when you think the patient entirely relieved you find, to your surprise, that destruction of the bone has been going on—the superior turbinated bone perishing.

The iodine solution may vary from half a grain to five grains to the ounce; the five-grain solution being applicable to syphilitic subjects only. And there must always be a distinction between syphilitic ozæna and ordinary Catarrh; the ordinary Catarrh in the otherwise healthy subject never gives rise to any very offensive discharge. The decomposition of mucus may be very readily recognized by its odor, so may the destructive changes which take place in the osseous tissues, and in the other tissues of the body affected with the syphilis, and what is known as strumous disease, which sometimes appears in the nose.

As a matter of observation, I have noticed that people who have Catarrh are prone to tie a knot in the corner of the handkerchief, or roll it around the end of the little finger and poke it up the nose for the purpose of removing incrusted matter, and in that way they abrade the surface, which creates a greater disposition upon the part of the secretion to adhere to this part and become dry and inspissated, and so the attempt to remove is repeated, and what was originally an abrasion gets to be a complete destruction of the whole membrane, with exposure of the bone, and exposure is likely to be followed by death of the bone, and in that way loss of the septum of the nose frequently results in ordinary cases of catarrh. In cases of syphilitic disease of the nose, attended with loss of the septum, or a portion of it, there is always great tumefaction of the surrounding parts. The marginal outlines are intensely red and considerably swollen, and this with the offensive character of the discharge, distinguishes the syphilitic from the traumatic sores.

Another form, called dry Catarrh, a proliferous inflammation with greatly diminished secretion, attacks persons given to excessive smoking. There is another form of Catarrh which is attended, not by dryness nor by any great moisture, but by swelling of the nasal membrane, with loss of the sense of smell, which is common to persons given to the habit of snuffing. There is the smoker's catarrh, the snuffer's catarrh, and epidemic catarrh.

In 1868, a German by the name of William Dumeyer, who kept a grocery at Market and Fourteenth streets, had a sore throat, and I wished to examine his larynx with the laryngoscope, but the fauces were so very sensitive to the approach of the mirror that I was obliged to use a solution of bromide of potassium, which I had learned was an efficient local anæsthetic. I gave Mr. Dumeyer a twenty-grain solution of bromide of potassium to be used as a gargle; that is the strength of the solution called the standard solution. It diminished the morbid sensibility of the fauces, and when I saw him again he said he did not need anything, he was well, and he wanted to settle his bill; he thought he was cured. I relate this to show you that the bromide destroys the sensibility of the membrane, and that suggested the application of it in the treatment of nasal catarrh. I formerly used this twenty-grain solution, which was regarded as the standard solution, for diminishing the morbid sensibility of the fauces, but I afterwards got into the habit of using a much stronger solution, even to saturation. I now sometimes, but rarely, use the saturated solution. Experience has convinced me that the weaker solution is better for general use with the atomizer. In many cases the catarrh is attended with the disagreeable symptom of the continued presence of mucus lying upon the soft palate and manifesting a disposition to find its way down into the throat. That class of cases is more common, and they are very troublesome sometimes. They may be prolonged indefinitely by the use of too strong applications—by too harsh a plan of treatment.

It has been, unfortunately, the practice of too many physicians to introduce brushes and mops, with caustic solutions, and in that way perpetuate the disease. I believe that the only true plan for the relief of catarrhal affections, like all other localized diseases, is to to search out the locality that that is chiefly affected, and direct the topical application to that point. In the class of cases under my consideration, where there are general symptoms of distress depending upon the presence of too much mucus lying upon the soft palate, and manifesting a disposition to flow down the throat, adhering to the uvula, a weak solution of bromide of potassium of five or ten grains is to be used. I employ what is known as Holmes' Boston Perfumer, held in such a manner that the fluid will find its way to the naso-pharyngeal space; and then snuffing it up the nose and hawking it out clears the surface entirely. Having cleansed both nostrils in this way, and having cleared the naso-pharyngeal space, a decoction of ordinary green tea, or a solution of five grains of carbolic acid and tannin to an ounce of water, or, as I generally prefer it, a mixture of equal parts of glycerine and water, is to be used immediately afterward, with the atomizer. This may be done three times every day; that is quite often enough. Cleanse the passages first with the bromide of potassium, which acts as a local anæsthetic, diminishing the morbid sensibility, and at the same time dissolving the fibrinous matter. Follow that with the decoction of green tea, or the solution of carbolic acid and tannin. (A favorite prescription is this: half a drachm each of carbolic acid and tannin, to be dissolved in three ounces each of glycerine and water. That is a mixture that I am in the habit of prescribing every day). It becomes necessary in many cases to make applications to the covering of the superior turbinated bones. These may consist of a half-drachm solution of carbolic acid to one ounce of water, or a half-drachm solution of iodine in glycerine, or a half-drachm solution of nitrate of silver to the ounce of water. These are the more common applications, and they are to be made with a brush or a little cotton-wool rolled upon the end of a probe, and the application is not to be repeated oftener than every other day. Catarrhal affections of the larynx generally call for local treatment. They are generally associated with bronchial Catarrh, which requires, in addition to local treatment, some constitutional measures. In the chronic forms of naso-pharyngeal Catarrh, constitutional measures are also required in a majority of instances. Where the affection invades the Eustachian tubes, creating an unpleasant noise in the ears that has been compared to the singing of grasshoppers, crickets, and steam escaping from a tea-kettle, the application should be made to the ear itself, and consist in filling the ear full of very warm water, and then have the head turned in a favorable position for the retention of the fluid, putting in a plug of cotton-wool to prevent the water escaping. Introduction of the Eustachain catheter may be practiced where there are evidently fluids in the tympanic cavity, or where the supply of air is deficient, and the patient cannot practice Valsalva's method, which consists in holding the mouth and nose shut, and blowing forcibly into the ears.

There should be no fluids blown through the catheter in this class of cases, and the use of the catheter should be restricted to the actual necessities of the patient for the removal of fluids from the tympanic cavity for the introduction of air.—*Med. and Surg. Reporter.*

TREATMENT OF HEADACHE.

A recent lecture by Prof. A. Smith, of the Bellevue Hospital Medical College, San Francisco, contains some valuable suggestions on the treatment of various forms of the Protean malady, headache. The following extracts will interest our professional readers:

A headache, when due to nervous disturbance, such as occurs in hysterical or excitable subjects, if associated with plethora, often yields to a saline cathartic. The most agreeable is the solution of citrate of magnesia, and should be given on an empty stomach. In addition, it is well to give one of the bromides combined with valerian. The following prescription I frequently use:

Sodii Bromidi.................. ....ʒ vj.
Elix. valer. amm..................... ....ʒ iv. M.

Sig. ʒ i. every hour until relieved.

If such nervous headache be associated with anæmia, after relieving the immediate attack with the bromide and valerian prescription, give iron, and give it for weeks, until there is a decided improvement in the patient's condition. Always give the iron after meals. In these anæmic cases it is often advisable to stimulate the heart's action. For this purpose I have found the following useful:

Amm. muriat..ʒ ss.
Tinct. actææ racemos..ʒ iij.
Aquæ..ʒ iij. M.

Sig. ʒ ij. after meals in a wineglass of water.

It is important to attend to the general health of the patient. Remove all causes of excitement; encourage exercise in the open air; let the food be simple but nutritious; let the sleeping-room be large and well ventilated; in short, let the patient be surrounded by the best possible hygienic influences. These general remarks will apply to almost all forms of headache. I usually recognize two forms of sick-headache (so-called), the one neuralgic in character, as hemicrania and trifacial neuralgia, the other a dyspeptic headache. In the neuralgic variety the pain in the head precedes the nausea, while in the dyspeptic variety the pain in the head succeeds the dyspeptic symptoms. In the neuralgic, vomiting does not relieve the pain, while in the dyspeptic an emetic or laxative often removes the pain in the head by removing the cause. In addition to the treatment given in a previous lecture for neuralgic headache, which often occurs at intervals of a few days, or a week or two, sometimes coming on at sunrise and disappearing at sunset, I have good results from the use of guarana, or Paullinia sorbilis, as it is sometimes called. I give it usually in powder, 15 grains every 15 minutes, until six doses have been taken. It is best given in a little sweetened water; and if six doses do not relieve, do not continue it; it will probably not relieve. It is well to give these powders in any headache (not malarial) of long standing and prone to return at certain intervals.

Dyspepsia is a frequent cause of headache.

If there is indigestible food in the stomach, and it has been there for some time, give an emetic, as mustard and warm water, or sulphate zinc grs. xv., and remove it. If there is evidence of indigestible food in the alimentary canal beyond the stomach, give gr. xx. of rhubarb and magnesia each, and remove it from the bowels. If the headache be frontal and the pain is located immediately over the eyes, give dilute nitro-muriatic acid in ten-drop doses, well diluted, after meals. If the pain is located about the roots of the hair, give an alkali before meals, as gr. xx. bicarbonate of soda or magnesia. The dyspeptic headache oftentimes is not confined to these regions, but spreads over the entire head. In such cases I combine an acid with an alkali, and add to these nux vomica, as in the following prescription:

Sod. bicarb...ʒ iiss.
Ac. nitro-mur. dil..ʒ ij.
Tinc. nuc. vom..ʒ iss.
Syr. aurant. cort...ʒ vj.
Aquæ, q. s. ad..℥ vj. M.
Sig. ℥ ss. after meals in a wineglass of water.

If there be gastric pain, a mild counter-irritant, as a mustard plaster to the epigastrium, will often relieve the pain in the head as well as the pain in the stomach. If flatulence be a troublesome symptom, give the following:

Bismuth subcarb...ʒ iss.
Tinct. nucis vom..ʒ iss.
Tinc. card. co..℥ iv.
Spts. lav. comp. q. s. ad...................................℥ iv. M.
Sig. ʒ ij. before meals in a wineglass of water.

If there be constipation, the following pill may be given, one in the morning:

Aloes pulv..ʒ ss.
Ext. nuc. vom...gr. v.
Ext. belladonnæ...gr. iv. M.
Div. in pil. No. xv.

In some forms of headache associated with stomach indigestion I have found small doses often repeated of tinct. nux vomica effectual. I give a single drop every fifteen minutes, and continue this two or three hours, if necessary. In other cases, where the headache comes on soon after a meal and seems to depend on delayed stomach digestion, large doses of pepsin are effectual. Give a half drachm of saccharated pepsin in a wineglass of sherry wine, t. i. d., and let it be taken during meals.

Cerebral congestion as a cause of headache may be divided into two varieties, active and passive. These claim almost directly opposite plans of treatment. In the active variety the patient should be kept in a darkened room, perfectly quiet, cold and evaporating lotions applied to the head. A saline cathartic may be given, and the following prescription:

Sodii bromidi..ʒ iiss.
Fld. ext. ergot.. ʒ iiss.
Syr. zinzib..℥ ss.
Aq. aurant. flor. q. s. ad...℥ iv. M.
  Sig. ℥ ss. q. 2 h.

If the skin be hot and dry, and the pulse full and rapid, give Fleming's tinct. aconit. rad. gtt. ii. q. 2 h, until the heart's action is sensibly diminished. Sometimes a hot mustard foot-bath will give relief.

The passive congestive variety demands a different mode of treatment. In many cases this variety is found associated with cardiac disease, and most frequently where there is predominant dilation. Hypertrophy gives rise to the active variety. Improve the condition of the blood by the use of iron, quinine, bitter tonics, alcoholic stimulants, good food, and stimulate the heart's action by the use of the following:

Tinct. digitalis..ʒ iij.
Spts. amm. aromat...ʒ vj.
Spts. lavand. co...℥ iij.
Syr. simp. q. s. ad...℥ iij. M.
  Sig. ʒ i. q. 4 h.

DENTIFRICES—GOOD AND BAD.

BY A. HOMER TREGO, D. D. S.

Dentifrice is derived from two words, *dens*, a tooth, and *fricane*, to rub. Why rub? Did nature intend teeth to be rubbed for some special purpose? No. It is because of the disobedience of nature's laws in diet, etc., that people are compelled to adopt artificial means for keeping their teeth clean. Keep clean? "Ah! there's the rub!"

Among the vast number of professional men of the past and present, there are but few who have arrived at a safe conclusion as regards the proper ingredients for dentifrices, or appreciate the danger of the general use of improper materials. The best authorities have found it highly important to denounce nearly all of the ingredients that have been and are now so universally prescribed and used.

Nearly all physicians and many dentists recommend castile soap or charcoal. All druggists use orris root, gum myrrh, orange peel, sugar, prepared chalk, soap, etc., etc., as the body of dentifrices. If they will investigate thoroughly they will find that they are very wrong. Soap, for instance, does not clean teeth. The same amount of friction with the brush and water will cleanse them better. The soap serves as a lubricator, causing the brush to glide smoothly over the teeth and gums; hence its popularity. No reasonable amount of scrubbing will remove the viscid effects of the soap from the mouth; it remains there as an irritant to the soft parts of the teeth and mucous membrane, and as an absorbent of calculi, forming a base for tartar, gangrene and decay. Fine soaps are composed of olive oil and soda. The olive oil is certainly not a detersive, and the soda certainly is a dangerous alkali. Mottled soaps are made so by use of green vitriol and sulphureted ley. A still greater danger is in store for those who use soap as a dentifrice. The cheaper grades are made of cheap ley and common oil, or more frequently of animal fat, and very often of animals that die of disease or poison, in and near large cities where the soap factories exist. Bad cases of diseased mouth are frequent subjects in the colleges—directly traceable to the use of soap. I have numerous cases of loose teeth—where every tooth seems to be lying around in a bed of ulceration. Ask the patients what they have used as dentifrices and the reply is soap, prescribed by Dr. Pillgarlick.

The most advertised tooth-wash extant is popular because it produces a froth in the mouth. It is composed of water, rum and soap bark (*quillaya saponaria*). The active principle of this bark is an acrid vegetable alkali. Well-known chemists and dentists who have tested it, pronounce it positively injurious, especially when used any length of time by delicate ladies and children. Rum and myrrh, as a mouth-wash, produce a froth. Myrrh is bad on account of being too pungent, and depositing a resinous precipitation about the teeth and gums. Orris root, orange peel, sugar, etc., are used only to add bulk and flavor, and on account of their pasty qualities are certain to leave deposits that form a dangerous nucleus for tartar—by absorbing acid and gas,

Charcoal, next after soap, is is the greatest nuisance any intelligent professional ever persisted in prescribing. All they claim for it is that it scours dirty teeth, and, being carbon, it absorbs the acids. Every patient I have seen that continued its use over a year, has scoured his teeth and gums almost to ruination. Microscopical examination shows every atom to be a sharpened flake that scratches, like a diamond, everything it comes in contact with. (It cannot be reduced to an impalpable powder.) These flakes are forced in the interstices of the teeth and under the gingival margins of the gums, where they retain acids, and transmit them to sensitive parts which they would not otherwise reach. When charcoal has been used a short time, blue lines may be seen under the margin of the gums. After continued use the necks of the teeth become exposed and sensitive and loose almost beyond remedy.

All gritty dentifrices have the same objectionable qualities. Salt is both acid and alkali, and has no merit as a *fricane.*

All acids and alkalis, like the aforementioned ingredients, are absolutely dangerous in a majority of cases. Like stimulating beverages, they may not show their bad effects in a day or week, but in a few months or years they become uncompromising destroyers. Borax and alum, for their astringent qualities, may be used temporarily in certain aphthous affections and mercurial sore mouth. They should be mixed with honey, sugar or sage.

For everybody's daily use, for keeping the teeth clean and the gums healthy, a mild astringent, antacid, antalkaline, styptic wash is decidedly the most pleasant, cheapest and only safe dentifrice known to the leaders of the profession. If properly prepared it dissolves the mucous calculi and other injurious secretions, and all can be readily removed from the mouth by the gentle use of a soft brush and rinsing with water.

In cases of predisposition to formation of tartar—from viscid secretions arising from disordered stomach—precipitated chalk should be used once a day, in connection with the wash. Always cleanse well between and on the inner sides of the teeth. Always use well-made brushes—those having plenty of soft bristles or badger's hair. For children, very small and soft brushes. Children's first teeth should be kept clean. They should be taught to brush their teeth every time they wash and comb their hair. "Cleanliness is next to Godliness," and the neglect of cleanliness is the direct cause of so much "toothcarpentering" being required. "Delays are dangerous and expensive."

POPULAR FALLACIES.

Night air and damp weather are held in great horror by multitudes of persons who are sickly or of weak constitutions; consequently, by avoiding the night air, and damp weather, and changeable weather, and weather that is considered too hot or too cold, they are kept within doors the much largest portion of their time, and as a matter of course continue invalids, more and more ripening for the grave every hour; the reason is, they are breathing an impure atmosphere nineteen-twentieths of their whole existence.

As nothing can wash us clean but pure water, so nothing can cleanse the blood, nothing can make health-giving blood, but the agency of pure air. So great is the tendency of the blood to become impure in consequence of waste and useless matters mixing with it as it passes through the body, that it requires a hogshead of air every hour of our lives to unload it of these impurities; but in proportion as this air in vitiated, in such proportion does it infallibly fail to relieve the blood of these impurities, and impure blood is the foundation of all disease. The great fact that those who are out of doors most, summer and winter, day and night, rain or shine, have the best health the world over, does of itself falsify the general impression that night air or any other out-door air is unhealthy as compared with in-door air at the same time.

Air is the great necessity of life; so much so, that if deprived of it for a moment, we perish; and so constant is the necessity of the blood for contact with the atmosphere, that every drop in the body is exposed to the air through the medium of the lungs every two minutes and a half of our existence.

Whatever may be the impurity of the out-door air of any locality, the indoor air of that locality is still more impure, because of the dust and decaying and odoriferous matters which are found in all dwellings. Besides, how can the in-door air be more healthy than the out-door air, other things being equal, when the dwelling is supplied with air from without?

To this very general law there is one exception, which it is of the highest importance to note. When the days are hot, and the nights cool, there are periods of time within each twenty-four hours, when it is safest to be in-doors, with doors and windows closed; that is to say, for the hour or two including sunrise and sunset, because about sunset the air cools, and the vapors which the heats of the day have caused to ascend far above us, condense and settle near the surface of the earth, so as to be breathed by the inhabitants; as the night grows colder these vapors sink lower, and are within a foot or two of the earth, so they are not breathed. As the sun rises, these same vapors are warmed, and begin to ascend, to be breathed again, but as the air becomes warmer, they are carried so far above our heads as to innocuous. Thus it is that the old citizens of Charleston, S. C., remember, that while it was considered important to live in the country during the summer, the common observation of the people originated the custom of riding into town, not in the cool of the evening or of the morning, but in the middle of the day. They did not understand the philosophy, but they observed the fact that those who came to the city at mid-day remained well, while those who did so early or late suffered from it.

All strangers at Rome are cautioned not to cross the Pontine marshes after the heat of the day is over- Sixteen of a ship's crew, touching at one of the West India islands, slept on shore several nights, and thirteen of them died of yellow fever in a few days, while of two hundred and eighty, who were freely ashore during the day, not a single case of illness occurred. The marshes above named are crossed in six or eight hours, and many travelers who do it in the night are attacked with mortal fevers. This does, at first sight, seem to indicate that night air is unwholesome, at least in the localities of virulent malarias, but there is no direct proof that the air about sunrise and sunset is not that which is productive of the mischief.

For the sake of eliciting the observations of intelligent men, we present our theory on this subject.

A person might cross these marshes with impunity, who would set out on his journey an hour or two after sundown, and finish it an hour or two before sun-up, especially if he began that journey on a hearty meal, because, in this way, he would be traveling in the cool of the night, which coolness keeps the malaria so near the surface of the earth as to prevent its being breathed to a hurtful extent.

But if it is deadly to sleep out of doors all night in a malarial locality, would it be necessarily fatal to sleep in a house in such a locality? It would not. It would be safer to sleep in the house, especially if the windows and doors were closed. The reason is, that the house has been warmed during the day, and if kept closed, it remains much warmer during the night in-doors than it is outdoors; consequently, the malaria is kept by this warmth so high above the head, and so rarified, as to be comparatively harmless. This may seem to some too nice a distinction altogether, but it will be found throughout the world of Nature that the works of the Almighty are most strikingly beautiful in their *minutiæ*, and these *minutiæ* are the foundation of His mightiest manifestations.

Thus it is, too, that what we call fever and ague might be banished from the country as a general disease, if two things were done. 1. Have a fire kindled every morning at day-light, from spring to fall in the family room, to which all the family should repair from their chambers, and there remain until breakfast is taken. 2. Let a fire be kindled in the family room a short time before sundown; let every member of the family repair to it, and there remain until supper is taken.

In both cases, ths philosophy of the course marked out consists in two things. *First.* The fire rarifies the malaria and causes it to ascend above the breathing point. *Second.* The food taken into the stomach creates an activity of circulation which repels disease.—*Hall's Journal of Health.*

HYGIENE OF THE EYES

A series of questions touching the care of the eyes were recently submitted to Dr. E. G. Loring, Jr., by the Medico-Legal Society of New York. Dr. Loring replied in a paper which has since been published in the *Medical Record.* To the first question—namely, whether bad air has any direct effect on the sight?—the author replies that vitiated air has a specially irritating influence on the mucous membrane of the eye; and that bad air, as a primal cause, may set in train morbid processes which not only will affect the working capacity and integrity of the organ, but may even lead to its total destruction. The second question was, whether size and quality of type would cause disease of the eye? According to Dr. Loring, the smallest print which a normal eye can readily recognize at at a distance of one foot is about one-fiftieth of an inch, and at eighteen inches is about one thirty-second of an inch. The normal eye should not be subjected for any length of time to a type smaller than *this size*, or one-sixteenth of an inch, and it would be better, after middle-life, to employ a type even a little larger than this; but the employment of spectacles removes in a great degree the necessity of a larger type with advancing years. The finer the type the closes the book has to be held to the eye, and the greater the demand on the focalizing power and the muscles that bring both eyes to bear at once upon the print. On the other hand, too coarse type is wearisome to the eye, requiring more exertions of the muscles that govern the movements of the eyes. The distance between the lines should be about one-eighth inch; nearer than this is apt to be confusing, farther apart is also confusing. Heavy-faced type is preferable to light-faced. An almost imperceptible yellow tint in the paper, "natural tint," is very desirable; pure white paper, especially if it has a metallic lustre with bluish tinge, should not be employed. The paper should be thick enough to be transparent, should have a close, fine texture, and be free from sponginess. To the third question—whether too long and constrained attention to one object, without rest or variety, will cause eye-disease?—Dr. Loring replies affirmatively, and assigns the physiological reasons. Finally, he was asked whether the angle at which the light strikes the eye is important? He replies that the light should not come directly in front; neither should it come directly behind. It should not come from the right side, because, in writing, the shadow of the hand falls across the page; and a moving shadow over a lighted surface not only reduces the quantity of light and leads to a stooping position, but it is also more more annoying to the eye than a uniform reduction of the illumination of even a greater degree. The best direction for the light to come is from the left-hand side, and from rather above than below the level of the hand.—*Popular Science Monthly.*

HIGH TEMPERATURE AND BOWEL-COMPLAINTS.

Dr. N. S. Davis, in a "Report on Clinical and Meteorological Records," communicated to the American Medical Association, an abstract of which we find in the *Medical Record*, reaches the conclusion that the bowel affections, so characteristic of this temperate climate, begin invariably with the first week of continuous high temperature, and that every subequent occurrence of several days and nights of continuous high temperature causes new attacks to be increased in number throughout the month of July, less in August, and still less in September; that it is not simply the extreme of heat, but its duration, which determines the number of attacks; that this continuous heat, to be efficient in producing these affections, must follow a protracted season of cold; and that, if we compare these deductions directly with statistics of mortality, we shall find them to conform in every particular in that the high rate of mortality follows exactly the same line. That fact was regarded as one of great importance in connection with sanitary measures which were to be adopted for the protection of life in infants; preventive measures must strike with the first week of high temperature. These conclusions were corroborated by quotations from mortality-tables.—*Popular Science Monthly.*

NATURAL HISTORY.

ENTOMOLOGY.

BY PROF. F. H. SNOW, KANSAS STATE UNIVERSITY, LAWRENCE.

Entomology, or the science of insects, has even in recent times been regarded with disfavor. Not more than forty years ago the distinguished M. Renous was arrested and brought to trial by the authorities of St. Fernando in Chili, upon the charge of witchcraft, because he kept certain caterpillars which turned into butterflies. Nearer home within the past three years, an essayist before the Kansas State Teachers' Association denounced the waste of time by young people in the pursuit of butterflies. During my own frequent excursions with long-handled net, cyanide-bottle, empty cigar-box and other collecting apparatus, I invariably encountered the astonished stare and incredulous smile of passers-by, who often seem to doubt the sanity of a man who deliberately devotes his time to "catching bugs." But it is not necessary before an intelligent audience to defend a science which has so intimate a connection with the professions of agriculture and horticulture.

This science embraces a broader field than any other department of Zoology. This is made clear when we consider that of the 250,000 living species included in the animal kingdom about 200,000 species or four-fifths of the whole belong to the single class of insects. The history of this immense array of living creatures is yet to be written. Comparatively little is known of the transformations and habits of the vast majority of insects.

A complete work on Entomology, which should devote but a single page to each species would occupy nearly 300 volumes of the size of our American Cyclopædia. Yet the celebrated Straus Durckheim devoted seven years to the study of a single species of beetle and embodied his results in a volume which will constitute a perpetual monument to the genius of its author.

Of the 200,000 species of insects thus far discovered upon our globe, some 50,000 are found in the United States, and it may be safely estimated that 10,000 species occur within the boundaries of the State of Kansas.

The impression exists among many that all insects are injurious, and the best friends of the farmer and fruit grower are too often destroyed by those whose zeal would be profitably mingled with knowledge. Of the *benefits* conferred by insects we may note the following:

1. The removal of offensive material from the face of the globe. Whole families of insects act as scavengers to purify the earth and air. Let an animal die and the mimic beetles and the skin beetles remove its dormal covering, thus allowing the army of flies to deposit their eggs within the flesh. Within five days all the softer material is removed and still other species attack the more obdurate portions of the carcass.

2. The destruction of noxious insects. Some of the largest families of beetles are exclusively carnivorous and destroy multitudes of insect pests. Such are the tiger beetles, the predaceous ground beetles and the lady-birds. The large green beetle known as the caterpillar hunter, eagerly devours the maple worm, the army worm, the canker worm and the locust. The lady-birds consume vast numbers of plant lice. I have bred three species of flies from the maggots which proved so destructive to our recent pest—the hateful locust. Nearly all injurious insects have some Ichneumon fly, or other parasite to reduce their otherwise overwhelming numbers.

3. The furnishing of food to other animals. Here we may cite the May fly (*Palingenia bilineati*) which has occurred in the winged condition along our rivers for some time, and both in the larva and in the perfect state supplies our fishes with abundant and wholesome food.

4. The furnishing to man of valuable products useful as medicines, dyes, wax, honey, silk, etc., etc. It is refreshing to note in these latter discouraging but now brightening days, that the silk raising experiment of Franklin county has proved so complete a success, and that the eggs of the silk worm raised in Kansas are the best that the world affords. Now that Kansas eclipses Japan in the French markets for this commodity, the propriety of extending the culture of the silk worm in our favorable climate need not be urged upon your consideration.

It is well known to entomologists that no less than fifty species of insects prey upon grains and grasses, thirty on garden vegetables, fifty on the grapevine, seventy-five on the apple, an equal number upon the pear, peach and plum, fifty on the oak, seventy-five on the walnut, and one hundred on the pine.

It becomes therefore an important question how we may protect ourselves from insect ravages. I would first suggest private measures. Every owner of a vineyard, orchard or farm should be on the alert to discover and destroy these noxious insects upon their first appearance. A species may exist in comparatively small numbers one season and be destroyed completely and with ease, but if left unmolested on account of its occasioning no apparent damage it will multiply almost incredibly, and the next season appear in overpowering numbers, annihilating its food plant. This was the case last month in a vineyard in which the fruit, foliage and young canes, which had been spared by the locusts, were entirely destroyed by the caterpillars of the beautiful moth known as the Eightspotted Forester. This insect appeared in the same vineyard last year without attracting much attention, and might have been exterminated with little trouble. Let me here commend to your notice the plan adopted by N. P, Deming, who found his orchard this year overwhelmingly attacked by that worst enemy of our apple trees—the Flat Headed Borer. He offered his son a reward of so much per hundred for all the beetles he would collect. I consider the plan of defence by destroying the insects as far as preferable to the protection of the trees by washes. The best of washes will soon be washed away by the rains or lose its strength under the summer sun, and even if made effectual by frequent renewal, the beetles are left alive to visit other orchards or to devastate the maples and oaks of our roadsides and forests. This thousand beetle females, and if we suppose each female to produce fifty eggs we see that by their destruction 25,000 borers have been "nipped in the bud."

5. The fertilization of plants. It is one of the wonderful facts of natural history that the two great kingdoms of plants and animals are so closely related that each is essential to the existence of the other. That animals could not live without plants, since from these they directly or indirectly derive their sustenance, is really understood. But that plants could not live without animals is a proposition which needs some explanation. Some plants, like the common squash, are so constructed that their staminate and pistillate blossoms are separate from each other. In such cases it is evident that the pollen must be conveyed from the stamens to the pistils by some external agency. This operation, though in some cases performed by the wind, is regularly accomplished by insects, which, in the repeated act of taking honey, convey the pollen from flower to flower, and thus secure the fertalization of the ovules. Other plants have perfect blossoms, containing both stamens and pistils, so that it would seem that there would be no need of insect agency to secure the growth of the seed. But it is found that when these perfect flowers are artificially guarded from the approach of insects, either no seed at all, or else very scanty and imperfect seed are produced. If a portion of a clover field be covered with gauze during the period of bloom so that the humble-bees can obtain no access to the blossoms, no seed whatever will be produced. Yet each clover head has an abundance of stamens and pistils. I observed the maple trees in front of my house (*Acer dasycarpum*) when in bloom in early spring. One tree had stamens only; the next tree had perfect blossoms, but the pistils were fully developed and ready to receive pollen while their own stamens were still in a rudimentary condition, and the hive bees were conveying the pollen from the first tree to the second. Two or three days later, when the pistils of the second tree had wilted, its stamens had reached maturity, and the bees were conveying their pollen to the pistils of a third tree. Thus flowers do not furnish honey to insects from purely disinterested motives, but with sweet allurements entice them to perform an act essential to the very existence of the vegetable kingdom.

6. The last benefit derived from insects to which I would briefly invite your attention is the restraining of vegetation within the proper bounds.

There is no doubt that in a state of nature the kingdom of plants would suffer great deterioriation if the number of individuals was not kept within reasonable limits by insect depredations. By this agency a disastrous crowding of vegetable growth is in a great measure prevented.

We now pass on to consider the large class of injurious insects. It has been shown that in a natural condition of things, destructive insects have their proper and useful position. But man interferes with the primitive relations of the world of nature, and for his own good establishes a new order of things. Instead of allowing the grapevines and fruit trees to remain in the forest, separated from one another and associated with hundreds of other species of vines and trees, he for his own convenience and comfort gathers the vines by themselves into vineyards, and the trees by themselves into orchards. He then improves the quality of the fruit by cultivation. But these altered conditions furnish vastly improved facilities for the multiplication of the many species of insects which find their homes upon or within the vines and trees. What were formerly useful pruners and restrainers of an over luxuriant vegetation, now become ruthless destroyers, and man must exercise his keenest intelligence to protect himself from ruin. The annual damage inflicted upon crops and fruits in the United States has been variously estimated from $300,000,000 to $500,000,000. An equal destruction of property by an army of invasion would cause our national government to expend millions of dollars in defence. The loss occasioned by the ravages of the Rocky Mountain or Hateful Locust during the past year, cannot fall below $100,000,000. Yet the total amount annually expended for the repression of insect foes by congress and all our state legislatuers combined does not exceed $18,000.

I would therefore suggest, under the head of public measures : 1st. Legislation to compel every man to keep his grounds free from insect pests. No one has a right to foster noxious agencies for the destruction of his neighbors' crops and fruit. 2. A bounty might be offered in certain cases by the county, state or general government for the capture of injurious insects. A reward of twenty-five cents a bushel for locusts during our recent visitation by this scourge would doubtless have prevented a large portion of the damage inflicted. Such a reward would certainly be as legitimate as the customary bounty for gopher skins. 3. The introduction of parasites should be undertaken by the general government. Many of our most destructive insects have been introduced from Europe. In the old country they have many parasites to keep them in check, but as yet few of these parasites have made their way to this country, so that our foreign foes have proved most destructive on account of the absence of their natural checks. That the plan proposed is a feasible one has been proved by Dr. Le Baron, the Illinois State Entomologist, who has successfully introduced into northern Illinois a parasite upon the apple bark louse. 4. Every State in the Union should employ a competent man as State Entomologist, who should give his whole time to the work of investigating the habits of insects, and disseminating information among the people. Messrs. Fitch, Riley and Le Baron have saved millions of dollars to the great States of New York, Missouri and Illinois, by their indefatigable entomological labors. The salaries paid to these men have been a thousand fold returned to the states employing them. 5. The legal protection of insectivorous birds. A commission should be appointed to determine what birds should receive this protection. 6. The plan proposed for the appointment of a national commission for the prevention of national calamities occasioned by insects is worthy of endorsement by every farmer and fruit-grower in the land. The petition to congress for such commission should receive universal signature. 7. I would finally suggest that if our people were more generally familiar with the subject of entomology and were able to distinguish between the beneficial and injurious insects, our universal enemies would be more intelligently and effectually resisted. To this end I would earnestly recommend the introduction into our schools of the elements of this extremely practical science. Independently of the educational advantages of natural history studies, the "practical" value of a knowlege of plants and insects, should forcibly commend botany and entomology to these who determine the course of training in our common schools.

THE HONEY-MAKING ANT OF TEXAS AND NEW MEXICO.

(*Myrmecocystus Mexicanus*, Westwood.)

The natural history of this very curious species is so little known that the preservation of every fact connected with its economy becomes a matter of considerable scientific importance, and the following observations gleaned from Captain W. B. Fleeson of San Francisco, who has recently had an opportunity of studying the aunts in their native haunts, may, it is hoped, be not without interest. The community appears to consist of three different kinds of ants, probably of two separate genera, whose offices in the general order of the nest seems to be entirely apart from each other, and who perform the labor alotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consists of yellow working ants of two kinds, one of which, of a pale golden yellow color, about one-third of an inch in length, acts as nursers and feeders of the honey-making kind, who do not quit the interior of the nest, "their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge into prepared receptacles, and which constitutes the food of the entire population. In these honey-secreting workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea." The third variety of ant is much larger, black in color, and with very formidable mandibles. For the purpose of better understanding the doings of this strange community, we will designate them as follows:

No. 1—Yellow workers; nursers and feeders. No. 2—Yellow workers, honey-makers. No. 3—Black workers; guards and purveyors. The site chosen for the nest is usually some sandy soil in the neighborhood of shrubs and flowers, and the space occupied is about from four to five feet square. Unlike the nest of most other ants, however, the surface of the soil is usually undisturbed, and, but for the presence of the insects themselves, presents a very different appearance from the ordinary communities, the ground having been subjected to no disturbance, and not pulverized and rendered loose as is the case with the majority of the species. The black workers (No. 3) surround the nest as guards or sentinels, and are always in a state of great activity. They form two lines of defence, moving different ways, their march always being along three sides of a square, one corps moving from the south-east to the south-west corner of the fortification, while the others proceed in the opposite direction. In most of the nests examined by Captain Fleeson the direction of the nest was usually towards the north; the east, west and the northern sides being surrounded by the soldiers, while the southern portion was left open and undefended. In case of any enemy approaching the encampment a number of guards leave their station in the line and sally forth to face the intruder, raising themselves upon their hind tarsi, and moving their somewhat formidable mandibles to and fro as if in defiance of their foe. Spiders, wasps, beetles, and other insects are, if they come too near to the hive, attacked by them in the most merciless manner, and the dead body of the vanquished is speedily removed from the neighborhood of the nest, the conquerers marching back to assume their places in the line of defense; their object in the destruction of other insects being the protection of their encampment, and not the obtaining of food. While one section of the black workers is thus engaged as sentinels, another and still more numerous division will be found busily employed in entering the quadrangle by a diagonal line bearing north-east, and carrying in their mouths flowers and fragments of aromatic leaves, which they deposit in the centre of the square. On the west side of the encampment there is a hole leading down to the interior of the nest, which is probably chiefly intended for the introduction of air, as in case of any individuals carrying their loads into it, they immediately emerge and bear them to the common heap, as if conscious of having been guilty of an error. A smaller hole near to the south-east corner of the square is the only other means by which the interior can be reached, and down this aperture the flowers gathered by the black workers are carried from the heap in the centre of the square, by a number of smaller yellow workers (No. 1), who with their weaker frames and less developed mouth-organs, seem adapted for the gentler offices of nurses for the colony within. It is remarkable that no black ant is ever seen upon one line, and no yellow one ever approaches the other's line, each keeping his own separate station and following his given line of duty with a steadfastness which is as wonderful as it is admirable. By removing the soil to a depth of about three feet, and tracing the course of the galleries from the entrance, a small excavation is reached, across which is spread in the form of a spider's web, a net-work of squares spun by the insects, the squares being about one-quarter inch across, and the ends of the web fastened firmly to the earth of the sides of the hollow space which forms the bottom of the excavation. In each one of the squares, supported by the web, sits one of the honey-making workers (No. 2), apparently in the condition of a prisoner, as it does not appear that these creatures ever quit the nest. Indeed, it would be difficult for them to do so, as their abdomens are so swollen out by the honey which they contain as to render locomotion a task of difficulty, if not to make it utterly impossible. The workers (No. 1) provide them with a constant supply of flowers and pollen, which by a process analogous to that of the bee, they convert into honey. The fact that the remainder of the inhabitants feed on the supply thus obtained, though it is surmised, has not been established by actual observation; indeed, with reference to many of the habits of these creatures, we are at present left in total ignorance, it being a reasonable supposition that, in insects so remarkable in many of their habits, other interesting facts are yet to be brought to light respecting them. It would be of great value to learn the specific rank of the black workers (No. 3), and to know the sexes of the species forming the community, their season and manner of pairing, and whether the honey-makers are themselves used as food, or if they excrete their saccharine fluid for the benefit of the inhabitants in general, and then proceed to distil more. The honey is much sought after by the Mexicans, who not only use it as a delicate article of food, but apply it to bruised and swollen limbs, ascribing to it great healing properties. The species is said to be very abundant in the neighborhood of Santa Fe, N. M., in which district the observations of Captain Fleeson were made —*Henry Edwards in London Journal of Applied Science.*

THE BRUSH AND COMB OF THE HYMENOPTERA.

Bees have always been noted for cleanliness of person. It appears to be necessary for them to take particular care in this respect of their antennæ. Any one who has observed bees and wasps, must have noticed how much time they spend in cleaning these mysterious organs; and, perhaps, will remember the singular, almost human-like motions—the careful, dexterous strokes in one direction, with which the work is done. One of the fore legs is thrown over the antenna of the same side of the head; the antenna is caught at a certain point of the leg, which at the proper instant is here slightly bent for the purpose; and then, with an outward and downward sweep, the antenna is drawn from its base towards its tip through this bend.

A little attention shows why the antenna is caught at a certain bend of the leg. There is a special apparatus at that particular spot, admirably adapted for the purpose. At the junction of the tibia and the tarsus is the apparatus mentioned. It comprises—first, a specialized spine, hinged, movable, brush-like, and projecting from the inner side of the leg; second, a deeply-cut, semi-circular notch, in the upper part of the first tarsal joint, fringed with a row of closely set teeth, like a curved comb. When the leg is bent towards the body at this point, the comb is accurately opposed to the brush, leaving a circular opening, through which the antenna is drawn, and neatly cleansed at every part of its circumference.

This developed spine is mentioned as a brush, because of its graceful, brush-like form in either species of the hymenoptera. In the honey bee it appears to have no especial fringe of bristles, but is membranous, thin, of irregular outline, and doubled, like a leaf with the edges curled towards each other, having the concave side opposed to the leg. The stout spines above and below the notch, are a few of the usual spines which abound on this part of the leg. The teeth of the comb are seen in a regular curve, fringing the inner contour of the notch, and pointing towards the centre of the opening.

The brush on the fore leg of a winged red ant well deserves the name. Its back, or convex side, is armed towards the tip with finely pointed projections; and its concave side, from the tip to a large pointed process in the neighborhood of the base, or for about two-thirds of its length, is fringed with long, closely set teeth, which must render the brush an admirable duster. There is no deep notch in the tarsus, as with the honey bee, but a decided curve, with a gently sweeping and extended comb.

The brush on the fore leg of the blue mud wasp (*Pelopœus cœruleus*) is large, prominent, and of strikingly graceful form, as might be expected from the characteristics of this species. The teeth of the brushing edge, opposed to the leg, begin quite near the base, and extend downwards in a prominent reversed curve to a large, pointed process, and are then succeeded by a close row of sharp spines to the tip. The teeth of the comb are set in a notch, in the upper part of the tarsus, very much like that of the honey bee, only not cut in with such a deep, short curve.

The white-horned horn-tail (*Urocerus albicornis*) is one of the largest of the hymenoptera. It has long, narrow wings, and a long, cylindrical body, giving it somewhat the appearance of a dragon-fly; but it is much more sluggish in its movements than the latter insect. The female is armed with a long, slender borer, hinged to the middle of the under side of the abdomen, with which she bores the trunk of the pine tree to deposit her eggs. In this insect the brush and comb would hardly be recognized, as they have been strangely transformed into what may be called a thumb and knives. The thumb is hinged to the lower end of the tibia, in the usual position of the brush. It is nearly straight, fleshy, cylindrical and ends in a slightly curved spinous tip. Instead of the comb, found on most other members of the great family of the hymenoptera, there is a long row of curious appendages, gradually increasing in size as they extend downwards, and set on the inner side of the enormously lengthened first tarsal joint. They rise from a somewhat bulbous base, continue for about one-third of their length with a cylindrical trunk, and then suddenly expand in an extremely thin and transparent blade.

They would evidently have formed a good model for the flint knives made by our progenitors of the "stone age." The back of each knife is directed downwards; while the cutting edge, taking a broad sweep from the handle to the extreme point, is directed upwards towards the thumb. In the individuals which I have examined, the thin upper edge of many of the knives appeared split and ragged, reminding one of the broken and frayed wings of the worker honey bee, after she has passed a few weeks in the severe labors of the honey harvest.—*American Journal of Microscopy.*

THE RIBBON FISH.

Frank Buckland, in a recent letter to *Land and Water*, says: "I have received, through the kindness of a correspondent at Nice, a very interesting and remarkable specimen of a ribbon fish. I make him out to be a *regalicus.* I have never before seen one of these most curious fishes in the flesh. It measures five feet, is about a quarter of an inch thick, and is of a silvery hue, not unlike the color of the 'silver-hair tail.' Upon the top of the head there are filaments, which, when stretched to their full, are about eight inches long. The head is very remarkable; altogether it is not unlike the shortened head of a horse. The mouth is prehensile, and so peculiarly formed that it is quite worthy of a figure; the eyes are very large and circular; the iris of a lustrous silver color. Behind the head the body is two and a half inches deep, in the middle two inches, at the tail a quarter of an inch. When held up to the light it is almost transparent; the vertebræ can with difficulty be seen, but with the movement of the fingers each vertebra will give a slight crack at the junction with its neighbor. The vertebræ are longest and thickest towards the tail end, at which there are sharp spines. It is covered everywhere with a fine silvery powder, which readily comes off in the hand. It has a crest of about an inch in height, which runs down the whole of the back. The rays forming the crest are united to double pillars of very slender bone. In substance it is very delicate, and begins to dry and harden almost immediately on exposure to the air.

"I cannot find much about this fish in any of my books. This family of ribbon-shape form consists of seven genera and twenty-six species. Mr. Swainson remarks of it as follows:

"'It contains the most singular and extraordinary fishes in creation. The form of the body, when compared to fishes better known, is much like that of an eel, the length of the body being in the same proportion to the breadth; but then it is generally so much compressed that these creatures have acquired the popular name of ribbon fish, lath, or deal fish. The body, indeed, is often not thicker, except in the middle, than is a sword, and being covered with the richest silver, and of great length, the undulating motions of these fishes in the sea must be resplendent and beautiful beyond measure. But the wonders of the mighty deep are almost hidden from the eye of man. These meteoric silver-coated fishes appear to live in the greatest depths, and it is only at long intervals, and after a succession of tempests, that a solitary individual is cast upon the shore with its delicate body torn and mutilated by the elements on the rocks, so that with few exceptions they are scarcely to be regarded as edible fish.'

"According to this authority, the Mediterranean has hitherto produced the largest proportion of the family, but it is distributed from the arctic regions to the sunny shores of India, so that probably a tithe has not yet been discovered."

BOOK REVIEWS.

BALDWIN'S PREHISTORIC NATIONS.

BY PROF. G. C. BROADHEAD.

All knowledge of mankind previous to our written histories is involved in obscurity, and by many is considered mythical. But industry and persevering research have availed much. The work before us by J. D. Baldwin and published by the Harpers, contains an apparent clearly connected train of what at first appearance is all mystery. The oldest civilization is traced to the ancient Cushites. From them, in direct descent, is traced the Chaldeans, and through them the Babylonians a little later. Another colony passed northwardly and settled Phœnicia. Another passed eastwardly and settled India, and they are now represented by certain inhabitants of the Dekhan. Still progressing eastwardly they may have penetrated Malacca. From Southern India they took possession of Ceylon, and there they flourished for many ages as a powerful and intelligent nation. Westwardly they crossed over and founded the ancient Kingdom of Egypt, of which we know so little. From Lower Egypt they ruled supreme in Upper Egypt and Abyssinia, and thence extended their settlements across the whole of Northern Africa.

The Phœnicians, long before Rome knew anything of civilization or of letters, sailed in ships to India, to Southern Africa and around Africa, founded the Empire of Carthage, built cities in Spain, brought tin from England and amber from the Baltic.

The Romans and Grecians, in their blind selfishness and jealousy, destroyed the records and evidences of culture of the conquered nations. The Phœnicians and Egyptians had their libraries, but where are they now? Destroyed, and mainly by the conquering nations. We only possess a few engravings on stone; yet Arabia and Phœnicia furnished the alphabet to the world.

In mechanical structures, we find that the ancients in many things even surpassed the moderns. Their stone edifices are wonderful. We have nothing like the Egyptian Pyramids or the temples of Karnac and Ipsamboul, and the rock cut temple at Elephanta, near Bombay, is wonderful. In Edoru there are found rock-cut palaces in remote places, only reached through deep canons ; also, uninhabited cities, the dwellings all cut in solid rock, and in a country not now capable of habitation. In Phœnicia are ruins of old walls built of pieces of stone larger than any of our ordinary machinery can lift.

There is traced a close relation in the civil government of all these nations. All possessed a somewhat republican form of government, each city possessing a district government of its own, as does now exist in central Arabia. Their religion was planet worship, and the serpent was symbolic, and there are evidences of Phallic worship among all these nations.

England has her stonehenge, so has Arabia. "Mac," signifying son, is used in Gaelic, and the African Berbers use "mac" in the same way as do the Tudas of the Indian peninsula use the term "Mag." The Irish probably came from Spain and previously from Africa.

That the Phœnicians traded to far distant places is known ; therefore, why may not their ships have crossed the Atlantic? In Mexico and Central America are ruins of stone structures of a Cushite type, and in Mexico and Peru are remains of roads cut through and over mountains in almost impassible places, evidences of mighty work. We find also relics of a worship similar to the ancient Cushites. In Colorado, in Arizona, in Ohio and other places are ruins of circular buildings resembling stonehenge, and evidences of sun worship.

The natives of Yucatan have traditions that a bearded white race came across the ocean from the east, and their historians describe three classes of ancient inhabitants : 1st, the Chicamecs or aborigines. 2d, the Colhuas, or first civilizers. 3d, the Nahuas or Toltecs, who came later as peaceable inhabitants, united with the uncivilized Chicamecs and secured power. The Colhuas were bearded white men, who came in the earliest times across the Atlantic. They built Palenque and other cities, and the oldest and finest monuments of the ancient civilizations, and established the great kingdom of Xibalba.

The traditions of Peru tell of a people who came by sea and landed on the Pacific coast, and the ancient Malay dialect extended across the Pacific as far as Easter Island.

Ancient Greek books speak of the island of Atlantis, great and powerful, and being in the ocean towards the west ; and it is not improbable that the Phœnicians in much older times sailed thence. The mythical story of this Atlantic island, Plato describes as divided into ten kingdoms, governed by five couples of twin sons of Poseidon, the eldest being supreme over the others, and the ten constituted a tribunal that managed the affairs of the Empire. The Yucatan tradition has also ten kings of Xibalba, who reigned in couples under Hun-Came and Vukub-Came. The etymology of atlas is found in the Nahuat tongue, *atl* meaning water, and at the time of the conquest the city of Atlan existed on the Atlantic side.

Diodorus Siculus also speaks of a great island over against Lilya, many days sail westward. Chinese records speak of their ships, during the 5th century, journeying to a country called Fa-Śang, distant 20,000 li from Ta Han, or 7,000 miles, or more.

I advise those who have not read Baldwin to get the book and read it. Also, a subsequent work of his on Ancient America.

THE ESSENTIALS OF ENGLISH GRAMMAR.*

The study of English Grammar by the younger scholars in our schools is probably as unmeaning, unsatisfactory and unprofitable as anything they can be set at. To say that they can learn to speak and write correctly without knowing anything of the rules governing the construction of sentences, and the proper use of the words composing them, seems rather paradoxical, but it is no more so than to say that one can learn to play or sing correctly without first learning the elements and principles of music. A boy of eight or ten years of age will readily perceive the correctness of such a sentence as "the fog came pouring in at every narrow chink and keyhole," while probably at fifteen he will stammer over and among the "predicate nouns," the "attributive adjectives" and the "adverbial predicates" in very helplessness.

From a careful examination of Professor Whitney's book we are convinced that it is the best work of the kind for teachers and advanced pupils in school that we have ever seen. He has undertaken to point out the essentials of English grammar only, and in doing so he avoids arbitrary rules and depends largely upon citations, quotations and illustrations for giving the learner so complete an understanding of his own language that he can state his ideas correctly and point out the principles involved in the construction of his sentences. The dissimilarity between Professor Whitney's definitions and descriptions of the various parts of speech and those of Kirkham, Lindley Murray and Smith will be so striking and interesting to those of our readers who studied grammar thirty years ago, as we did, and have not kept watch of the works on grammar used in the schools since then, that we will point a few for their edification.

At that time and by the authors above named, a verb was defined to be a word which expressed "to be, to do or to suffer." Professor Whitney describes it as "a word that asserts or declares, and hence that can stand alone or with other words as the predicate of a sentence." Those old teachers gave the verb five moods and six tenses. Some later writers have dropped, or attempted to drop, the subjunctive mood. Professor Whitney discards both potential and infinitive, the latter of which he calls a "verbal noun," and refers to the subjunctive as "almost lost and out of mind." He

*By Prof. Whitney, of Yale College. Published by Ginn & Heath, Boston.

also reduces the tenses to two, present and preterit, calling the others "verb phrases or compound verbal forms." We also find the verb *to be* among the "verbs of incomplete predication:" the old-fashioned present passive participle *being loved* is called a "present passive participial infinitive phrase." The passive voice is so far abandoned, with the exception of the present and past or perfect passive participle, that such a form of speech as "was broken" is described as "a passive verb phrase, composed of the auxiliary *was* and the past participle *broken* of the verb *break*."

We miss the adjective pronouns and find them classed as "indefinite pronominal adjectives." Conjunctions have been changed from "copulative and disjunctive" to "co-ordinating" and "subordinating." Other changes equally striking have been made, but we have given enough to serve the purpose named.

The chapters upon Sentences and parts of speech; Derivation and composition, and Syntax, are excellent, and full of condensed information and instruction. They seem to have received the commendation of all critics, teachers and professors who have given their views to the public, and are deserving of the perusal of all lovers of fine work.

The explanations of the causes for the various rules given are simple and clear, and, followed as they are, by illustrations and examples for parsing, these rules make a much greater impression than when arbitrarily stated in the usual manner. It appears also that much of the "tedious nomenclature" of the more recent school grammars has been cleared away, which, of course, will popularize it with the teachers, one of the most distinguished of whom says, "it is philosophical, without formality, and leads the student beyond the mere mechanics of language to its life."

It bears the evidences, in every part, of the hand of the philologist as well as that of the grammarian. In fact, we think that the former preponderates in many instances, although the style is extremely simple and unpretentious.

The objection, if there be any, seems to be that as a text book for younger students it is too lax and devoid of fixed rules, and thus too much liberty is given for the introduction of expressions which have no higher origin than rather common usage, especially in the substitution of adjectives for adverbs and the allowing of the use of the objective case after impersonal and neuter verbs. For teachers and older pupils, whose principles of correct writing and speaking are fixed, so to speak, it may be well enough to depend upon illustrations to give a certain necessary freedom or absence of formality of style, but to beginners, too much rigid adherence to absolute rules cannot be inculcated.

We also think that the author might have been a little more particular in the selection of some of his illustrations, as they involve forms of speech and grammatical construction which are not, as far as we can observe, provided for among the rules laid down.

We also observe a carelessness in the construction of some of the sentences and in the punctuation of parts of his Preface, which is hardly compatible with good grammar, and inclines us to think that he has carried to too great an extent one of the theories advanced in this preface, that "correctness in writing is only one (of the purposes of the study of English grammar) and a secondary and subordinate one at that—by no means unimportant, but best attained when sought indirectly." Such things are undoubtedly due to the fact that an eminent philologist is liable to overlook some of the *minutiæ* in giving attention to the great principles involved in the discussion of the subject.

The arrangement of the work is admirable, and the typography and general execution of the mechanical part are far superior to that of the ordinary run of school books.—[Ed.]

SCIENTIFIC MISCELLANY.

THE ADULTERATION OF FOOD.

We take the following extracts on the adulteration of food from an article which recently appeared in the *Evening Post*:

"While it is certain that needless alarm is frequently excited by exaggerated statements regarding food adulteration, there can be no doubt that many of the articles of food met with at our tables often contain foreign ingredients which are introduced either for the purpose of lessening their cost or improving their taste and appearauce.

Flour is subjected to adulteration with other and inferior meals, such as rice, beans, rye, potatoes, and Indian corn, the addition of which cheapens the price and in some cases bestows a good color upon a damaged or inferior grade, or causes it to take up an abnormally large quantity of water. The addition of foreign meals to flour is practised, however, almost exclusively in Europe, as most of the substances of this class used have in this country a greater value than pure wheaten flour. A more probable adulteration with us is the use of alum and mineral substances; the former is occasionally employed to impart a white color to the flour, the latter, which include sulphate of lime, kaolin, chalk, and bonedust, being used to produce increased weight. It has quite recently come to light that a flour containing ten per centum of a mixture of chalk, plaster of Paris, and barytes has for some time formed a steady article of export from Holland into other European countries. The presence of such substances as these can be detected by placing the flour in a long tube nearly filled with chloroform, shaking the mixture, and allowing it to stand, when the pure flour will rise to the top of the liquid, the heavier mineral adulterants sinking to the bottom.

Bread naturally contains the foreign ingredients added to the flour from which it is made; but in addition to these, other substances are used in its preparation. Alum is employed to prevent the action of the diastaste upon the starch, and to prevent the bread from becoming sour and mouldy; and although this salt tends to accomplish these results and imparts a fine white appearance to the bread, its use is not justifiable. When taken into the stomach it is liable to occasion acidity and dyspepsia; furthermore, it prevents a solution of a large proportion of the gluten of the bread, thereby causing a decrease of its nutritious value. A far more reprehensible adulteration consists in the addition of sulphate of copper, which has the same effect on the color of the bread and on the diastase. Although this salt is but seldom employed, and then in very small amounts, its use is to be condemned in the strongest terms, as it acts as a virulent poison, and its effects are cumulative. A simple and delicate test for detecting the presence of copper is to moisten the suspected bread with a few drops of solution of ferrocyanide of potassium, which will cause a pinkish color to become apparent if the metal be present.

Pickles and preserves are often artificially colored. The deep green color frequently noticeable in the former is almost invariably due to the presence of a sort of copper (the sulphate or acetate), which is either directly added to them or is produced in using copper vessels in their preparation, both methods being recommended in several cooking books. This adulteration can be detected by allowing a piece of clean and polished iron to remain immersed in the pickling vinegar for a few hours; in presence of copper a thin coating of this metal will be deposited upon the iron.

The condiments used at the table are also frequently far from pure. Additional acidity is often imparted to vinegar by the addition of sulphuric acid, the use of which was formerly considered necessary in order to prevent its decomposition, and was allowed by law in Great Britain; but although the fallacy of this belief has been demonstrated, the practice is still resorted to. A few weeks ago five carloads of vinegar received in Washington from Chicago were found to contain over fifty-four grains of sulphuric acid per gallon, in the form of suphate of lime, in addition to five grains per gallon of the free acid. On adding a little nitrate of baryta to vinegar containing sulphuric acid, a heavy white precipitate will be immediately formed.

The sophistications practiced upon tea are large in number and often harmful in character. The greater part of the adulteration occurs in China, but the English and Americans appear to have become skillful imitators of the Chinese in at least some branches of this nefarious industry. Mineral and organic substances are used to increase the weight and bulk of the tea; fictitious strength is imparted to it by the addition of certain vegetable substances and pigments are employed in order to produce a desirable color. The operation which is most generally carried on, at least in this country, is the artificial "facing" or coloring of teas. This practice is almost entirely confined to green teas, of which, it is said on high authority, but few grades reach the consumer in a pure state. The pigments most used for coloring green teas are Prussian blue, indigo, turmeric and china clay; the peculiar glossy appearance they frequently present being produced by means of black lead, talc, and soapstone. Other and far more dangerous substances, such as arsenite of copper, chromate of lead, and Dutch pink, are said to be sometimes employed. When hot water is poured upon a faced tea, the coloring matter present often becomes detached and either rises to the top or sinks to the bottom of the liquid, forming a sediment which can be readily recognized as a foreign body, especially by aid of a magnifying glass.

Coffee is probably more extensively adulterated than any article yet mentioned. When sold in the ground state it almost invariably consists of a mixture containing little or no coffee and a great deal of chicory and roasted grains, such as peas, beans, rye and wheat. The addition of chicory is frequently defended on the ground that it improves the taste and quality of the coffee; but owing to its comparative cheapness, there is a great temptation to use an undue quantity of this substance, and unless the amount of the addition is specified on the packages (as is required in several European countries), it undoubtedly constitutes a true adulteration; moreover, chicory itself is very often mixed with foreign substances. Pure coffee will remain floating upon the surface of the water for some time, and fails to impart a perceptible color to it, whereas chicory and beans (especially the former), at once sink to to the bottom and color the liquid decidedly. Other substances which also rise to the surface of the water can be easily distinguished from coffee by their appearance and taste. A simple test is to spread the coffee out on a slip of glass, slightly moisten it with water, and then touch the layer in different parts with the point of a needle; in this way the presence of soft, non-resisting foreign ingredients can be easily detected.

The artificial coloring of confectionery also merits consideration, owing to the important sanitary effects involved. One of the most common and deleterious substances used in the coloring of confectionery is chromate of lead, which is employed for the production of a yellow color. Red, another favorite hue, is obtained by means of cochineal, but such poisonous compounds as red lead and vermillion are also sometimes used for its production. Green and blue colors, which are fortunately less often met with, are usually produced by means of Prussian blue, Brunswick green, Scheele's green, etc., all of which must be classed as dangerous substances. These colors can be obtained by using vegetable dyes which are quite harmless; and although the tints are then less brilliant, this fact is certainly no excuse for resorting to poisonous pigments.

In most foreign countries effective means have been adopted to expose and prevent the adulteration of food, but with us little has been accomplished in this direction. In Europe boards of public analysis are appointed, who carefully examine suspected articles of food; here this duty usually devolves upon some member of the local board of health, whose time, as a rule, is fully occupied by other employment. During the last few years our Custom House officials have exercised commendable care in regard to the quality of the drugs admitted through the customs, and the questions naturally arises: Should not at least equal importance be attached to the subject of the purity of the food sold by our grocers and consumed by our families?—*Scientific American.*

REMOVAL OF STAINS FROM WOVEN FABRICS.

The following practical hints on this subject, condensed from the best foreign sources, will furnish the readers of the *Journal* much useful information in small space:

Mechanically attached particles may be removed from all fabrics by beating, brushing, and allowing water to fall from an elevation upon the wrong side of the goods.

Mucilage, mucus, sugar, jelly—Washing with lukewarm water will clear all goods.

Fats.—From white goods, wash out with soap and lye. Colored cottons, wash with lukewarm water and soap. Colored woolens, lukewarm soap and water, or ammonia. Silks, clean carefully with benzole, ether, ammonia, magnesia, chalk, clay, or yolk of eggs.

Oil colors, varnish rosin.—From all fabrics except silk, oil of turpentine, alcohol, benzole, and then soap. Silks, benzole, ether, and soap very carefully, and in a very weak solution.

Stearine can be removed from all goods with strong, pure alcohol.

Vegetable colors, red wine, fruits, red ink.—From white goods, sulphurous vapor or hot chlorine water. Colored cotton or woolen goods, wash in lukewarm water and soap, or ammonia. Silks may be treated in the same manner, but very cautiously.

Alizarine inks.—From white goods, tartaric acid; the older the spot the more concentrated. Colored cottons or woolen goods, if color permits, dilute tartaric acid. Silks, as before but with great caution.

Blood and albuminous spots.—Simply washing out with lukewarm water, for all kinds of goods,

Rust and spots of ink made of nutgalls.—From white goods, hot oxalic acid, dilute hydro-chloric acid and then tin filings. Colored cottons or woolens, citric acid may be tried. White woolens, dilute hydro-chloric acid. Silks, nothing can be done without increasing the evil.

Lime, lye and alkalies in general.—From white goods, simply wash in water. Colored cottons, woolens or silks, much diluted citric acid, drop by drop upon the moistened spot, to be spread around by the finger.

Acids, vinegar, sour wine, fruit juices, etc.—From white goods, simply washing; in the case of fruit also with hot chlorine water. Colored goods either cotton, wool or silk, according to the delicacy of the material and the color, more or less diluted ammonia, to be spread around on the spot, moistened, drop by drop, with the tip of the finger.

Tar, wheel grease, as also fat, rosin, carbonaceous particles, and wood vinegar.—From white goods, soap with oil of turpentine, varied with the action of falling water. From colored cotton or woolens, hog's lard to be rubbed on, and then soaped, and allowed to remain quietly; then washed alternately with water and oil of turpentine. From silks, as in the preceding but more carefully, and instead of turpentine, benzole and a continual current of water falling from a height, and only upon the reversed side of the spot.

For cleaning silks soiled and greased, but not thoroughly discolored by acids, etc., the best agent is ox-gall diluted with lukewarm water and strained. Blood and albumen should simply be soaked in cold water.

Superficial loss of substance by scorching.—For white goods, rub over thoroughly with a pad dipped in hot chlorine water. Colored cotton or woolens, whenever possible color over or raise up the nap. With silks nothing can be done.—*Boston Journal of Chemistry.*

THE DEVIL FISH.

At a meeting of the Chicago Academy of Science, Dr. Velie made a report of his explorations along the coast of Florida, in search of natural and archæological curiosities. On this trip, he was accompanied by his brother Mr. A. E. Velie, of Aurora, and Dr. Hammond, of Genesseo, Ill. The expedition was rich in results, and the Doctor brought home with him a very large collection of valuable specimens for the museum of the academy His report was very brief, consisting of little more than a description of his voyage and a list of the curiosities which he had collected.

Not the least of these was a devil fish, which formed the subject of a paper by Professor Peabody, who entered minutely into its character, disposition, and habits. The body of the fish was large, the transverse exceeding the longitudinal diameter, skin rough, but without any evident tubercles or spines; head not distinct from the body, subtruncate in front, slightly convex; mouth subterminal, with very small teeth in seven or eight rows; nostrils small, and placed near the angles of the mouth; eyes prominent, lateral, and placed on eminences at the base of the frontal appendices; bronchial apertures narrow, linear varying from one to two feet in length, with valvular covering; tail long, slender, subcompressed, terminating in a slender extremity; dorsal fin at base of tail, small and triangular. The dimensions of Dr. Velie's specimen are as follows:

Width at pectorals, 10 feet 2 inches; length, exclusive of tail, 5 feet 5 inches; length of tail, 4 feet 2 inches; thickness of body, 1 foot 6 inches; length of frontal appendices, 1 foot; width of frontal appendices, 6 inches.

The back of the male is black, while the female has a broad, angulated belt of a lighter color crossing the back immediately behind the eyes. The specimen captured by Dr. Velie is a female. It is a comparatively small fish, as those described by Elliott and De Kay were seventeen or eighteen feet in width, and others of equal dimensions have frequently been encountered, though rarely captured.

Professor Peabody related several anecdotes illustrative of the strength of the devil fish. One, eighteen feet broad, towed a thirteen ton schooner, with all sails set, in the face of a brisk wind, until the harpoon drew out and the fish escaped. Dr. Velie experienced great difficulty in making his capture. He harpooned five other fish, but lost them all. The one captured succumbed only after an hour's struggle. Among the means of assault which the fish possesses are its frontal appendices, which are movable, and with which it can seize and hold, as by power of suction, anything coming within reach. In this respect only does it resemble the devil fish known to the readers of Victor Hugo. The food of the devil fish has been supposed to be crustaceans. Some scientists are of opinion that it lives on other fish, but no scales have ever been found in its stomach. The stomach of Dr. Velie's specimen contained a large quantity of a reddish, moss-like substance, which Professor Reinsch, of Bavaria, one of ths members of the Chicago Academy, identified as sea-weed, possibly a new species.—*Chicago Tribune.*

The planet Mars, now so near us, has had to give up another of his secrets. Prof. Hall, in charge of the great telescope at the Naval Observatory at Washington, has discovered two satellites of that planet. The discovery was made last Thursday night, and was fully tested afterwards by the astronomers at that station. Prof. Newcomb telegraphed the discovery to the European observatories. It is looked upon as one of the most marked astronomical events of the century, and a great triumph for the new telescope. Prof. Hall says:

"The first satellite of Mars was discovered in the Naval Observatory at Washington on the night of August 16. It was first seen at 11:42. It has been observed in the nights of the 16th, 17th, and 18th of August. The time of the rotation of this satellite about Mars is about thirty hours; its greatest apparent distance from the center of Mars is eighty seconds of an arc. I think I saw another satellite Saturday morning about 4 o'clock, but of the existence of the second satellite I am not absolutely certain. I believe, however, that there are two, and expect to be able to determine this to-night. In its appearance it is a faint object of about the thirteenth or fourteenth magnitude. It was possible to discover the satellite only by putting Mars, which is exceedingly bright, out of the field of the telescope, so as to get rid of the bright light of that planet."

The distance of the first satellite is from Mars about 13,000 or 14,000 miles, and its diameter probably not more than 50 to 100 miles, and is nearer than the satellite of any known planet.—*Kansas City Journal of Commerce.*

DISTINCTIVE FLORA OF ARIZONA.

J. A. Spring, a botanist of Tucson, sends to the San Francisco *Post* an account of the distinctive flora of Arizona. Some peculiar uses of the strange plants are described. The candelabra cactus has been employed by the Apache Indians for communicating signals; its height is fifteen or twenty feet, but occasionally specimens are found fifty feet high. To make it a signal light it is only necessary to set fire near the ground to one of the vertical rows of prickles with which the plant is adorned; the flame runs to the top, and the candelabra becomes a torch. But the plant is not destroyed, nor apparently injured, by such burning on the surface. When dead and dry the wood is found to be hollow, and it separates at once into a number of sticks or poles, these having been chiefly held together by the rind. The fruit of this cactus makes a pleasant preserve. That of another, the "prickly pear," is well known to travelers. The young leaves of the prickly pear cactus are cooked as a vegetable, the dish produced being something like string beans in appearance and taste; the leaves are also highly esteemed for use in making a poultice to draw a splinter. The "nigger-head" cactus furnishes ready-made fish-hooks in countless numbers; by surrounding the plant with fire it produces water for the thirsty traveler, the heat driving its fluid to the interior, whence nearly a half gallon is obtained. "Maguey" is a palatable preparation made by roasting the leafy heads of the century plant; it saved a whole garrison in Arizona, ten years ago, from scurvy.

EDITORIAL NOTES.

CLOSE OF THE FIRST VOLUME.

With this number of the Review the first half year of its existence closes, and upon looking it over we are pretty well satisfied with it. We have given our readers three hundred and eighty-four pages of good, substantial, reliable reading, and have distributed for our advertisers six thousand copies of a handsome, well printed periodical, in more than half of the States in the Union, but especially in Kansas, Missouri and Colorado, where it has reached not less than four or five times as many readers. We have been cordially welcomed by the scientific periodicals of the country, and already number most of them among our exchanges, and have received compliments and congratulations from the daily and weekly papers on all sides.

We have published original articles from some of the best observers, writers and scientific workers of the West, such as Broadhead, Kedzie, Snow, West, Halley, Berthoud and Crosby, and compilations and condensations which have cost us a great deal of labor and time, besides selections from many of the best journals in the world. The main thing wanting now to make the Review a permanent success is more subscribers and a few more advertisers. We feel that we ought to have both, not as a gratuity, but simply because our periodical is worthy of them, and will repay both as a business investment.

The *Boston Journal of Chemistry* notes that at a recent meeting of the Massachusetts Dental Society, in Salem, Dr. S. F. Waters stated that the application of bi-carbonate of soda, that is, plain cooking soda, to be found in all households, or other alkalies in a neutral form, would cause instantaneous cessation of pain from the severest burns or scalds, and that in all cases of mere superficial burning the treatment would effect a cure in the course of a few hours.

THE Fourth of July was celebrated at Summit, Colorado, by a snow-ball party, on snow-shoes, which afterward resolved itself into a flower-gathering party, the situation admitting of persons standing on the snow three feet deep and picking a large variety of Alpine flowers from the uncovered ground beyond the snow.

THE POPULAR SCIENCE MONTHLY for September opens with another able original paper, by Herbert Spencer, on the development of the domestic relations. The next article, "Odd Forms among Fishes," is by the late Professor Sanborn Tenney, who gives a very interesting account of sundry curious divergences from the typical pattern in this division of animal life. The Observatories of Italy are briefly described in the third article, with the work that each is doing. "On Drops" is a short but fully illustrated account of some remarkable experiments, showing the curious shapes which drops of fluid take on striking a hard surface. "Civilization and Morals," by Mr. J. N. Larned, is an instructive discussion of man's various relationships. The eighth article, "Instinct and Intelligence," by W. K. Brooks, of John Hopkins University, is of great interest, as tending to show that the distinction hitherto erected between men and animals in this regard has no actual existence in Nature. Among the five other papers that go to make up the body of the magazine, all of which will fully repay the reader, there is a short but incisive article on "The Labor-Question;" and a sketch, with portrait, of Prof. Simon Newcomb. The departments including Correspondence and Editor's Table are, as usual, full of interest and instruction. They contain pointed discussions of current scientific questions, notices of the latest scientific books, and, in the Popular Miscellany, brief but clearly-written abstracts of recent papers, and descriptions of new discoveries from the principal centers of scientific activity both at home and abroad.

OUR old friend and fellow-citizen, Gen. Wm. H. Powell, has become general manager of the Belleville Nail Works, at Belleville, Ill., and has taken out a patent for a method of converting old railroad iron into first-class nails, which is described by the *Mines, Metals and Arts* as follows: "The result of various experimental tests show the following combination of materials to be the most desirable: 56,000 lbs. of old rails, 3,000 lbs. No. 2 pig iron and 3,000 lbs. of wrought scrap, producing 26 300-2240 tons of muck bar, which is a day's production. Gen. Powell's patent covers the method of piling the faggot so as to secure a homogeneous bloom, which results as follows: The faggot is piled to so secure a perfect interspersion of the good heads, added to muck bar and cindery scrap, with the shanks and flanges as to realize in the next pile and the plate rolled therefrom strong, tough and smooth nail plates. In this process the waste is less than six per cent., and good nails are produced under the Powell process fifty cents per keg below the cost of nails made by the current system."

DR. FLEURY, of Bordeaux, a French physician, finds good physiological grounds for the habitual use of the right hand instead of the left. He says that in human brains the left anterior lobe is a little larger than the right one. There is also an unequal supply of blood to the two sides of the body. The brachio-cephalic trunk, which only exists on the right of the arch of the aorta, produces, by a difference in termination, an inequality in the waves of red blood which travel from right to left. Moreover, the diameters of the subclavian arteries on each side are different, that on the right being noticeably larger. The left lobe of the brain, therefore, being more richly hæmatosed than the right, becomes stronger; and as, by the intersection of the nervous fiber, it commands the right side of the body, it is obvious that that side will be more readily controlled. This furnishes one reason for the natural preference for the right hand, and another is found in the increased supply of blood from the subclavian artery.

MR. ALLAN BAGOT, consulting electrician, of London, England, writes to the *Colliery*

Guardian that stockholders in gas companies need not seriously alarmed by the prospect of M. Joblochkoff's electric light superseding gas for street light. First, because of the great liability to damage, and difficulty of repairing of the wires, etc.; second, the expense of organizing a successful system of lighting street lamps; third, the necessity of replacing the exhausted candles hourly, if M. Joblochkoff's system be adopted.

HISTORICAL SKETCH OF MARIETTA COLLEGE (Ohio), by Rev. I. W. Andrews, L.L. D., President.

This institution was founded December 17, 1832, and from that day to this has made steady progress, never having suffered from dissensions among its trustees or faculty, and never having been "puffed up" by any remarkable periods of success. It has always had the best of professors and teachers, and has regularly graduated its classes and sent out men, full armed, who have been a credit to the institution wherever they have gone. The college was originally molded upon the New England type, and its course of study and general plan continues to be substantially the same as at Dartmouth, Middlebury, Amherst, Yale and Williams colleges.

The libraries, aggregating 27,000 volumes, have been selected with the greatest care, and some 15,000 of the most valuable books were purchased by the late President, Henry Smith, D. D., in Europe, at a cost of less than one-third the price they would have cost in this country. At the death of the eminent naturalist, S. P. Hildreth, M. D., his large and most valuable collection of minerals, etc., was given to the college; in addition to which it has a most excellent cabinet, largely accumulated by Prof. E. B. Andrews.

The course of instruction and requisites for graduation have always been of an unusually high standard for a Western college, and many of the alumni of Marietta have become professors in other colleges both east and west of Ohio. The town of Marietta itself is a most delightful place of residence, and no college that we know of presents more advantages to the student, either in a literary or social point of view.

THE London *Telegraphic Journal*, for July 15th, comes to us adorned with a striking photograph of the eminent scientist, Michael Faraday, who was born in 1791, and after a long and most successful life, died in 1867. His studies and experiments were chiefly in the departments of electricity and magnetism, and so universally recognized were his talents and ability that "he was decorated with no less than 95 titles and marks of merit, including the Blue Ribbon of Science, for, in 1844 he was chosen one of the eight foreign associates of the French academy."

WE are informed that since the article on the Wyandotte gas well was written the Company has made a contract for laying the mains into the City of Wyandotte, so that we shall soon be able to test not only the quality but the quantity of the gas from this natural reservoir. Should both equal their expectations it will prove a very valuable discovery for the manufacturers of this immediate region.

PROFESSOR SNOW'S article on Entomology which we publish this month, was read at the last annual meeting of the Kansas State Academy of Science, and copied by us from the Leavenworth Daily *Times*. It is an excellent and most practical paper, full of useful information upon a rather neglected branch of popular education.

PROF. E. L. YOUMANS is engaged upon an "American Household Cyclopædia," a dictionary of all things pertaining to domestic life, to be published this fall by D. Appleton & Co.

BOOK NOTICES.

MACMILLAN & Co., publishers of scientific works, London and New York, have sent us the following SCIENCE LECTURES FOR THE PEOPLE, viz:

Why the Earth's Chemistry is as it is: three lectures by J. Norman Lockyer, F. R. S.

The Succession of Life on the Earth: three lectures by Prof. W. C. Williamson, F. R. S.

What the Earth is Composed of: three lectures by Prof. Roscoe, F. R. S.

The Steam Engine: by F. J. Bramwell, Esq., M. Inst., C. E., F. R. S.

Outlines of Field Geology: by Prof. Geikie, LL.D., F. R. S.

All of these are handsomely illustrated and constitute a series of most interesting and valuable contributions to the literature of popular science. We have already published several extracts from some of these and shall avail ourselves again of them as occasion arises.

THE MONTHLY WEATHER REVIEW, July, 1877, issued by the Signal Office, Washington, D. C., depends upon all data received up to the 14th August from the Canadian Meteorological Service, the United States Navy, the Army Post Surgeons, Voluntary Observers and the United States Signal Service, and contains classified reports and information upon the following subjects, viz: Barometric pressure, with chart; Temperature of the Air, with isothermal chart; Precipitation, with chart showing general distribution of rain during the month; Relative Humidity; Winds, with chart; Verifications of Predictions, with detailed comparisons of the tri-daily weather indications with telegraphic weather reports for the succeding twenty-four hours; Navigation, with chart showing highest and lowest readings on river gauges for the month; Temperature of water in rivers and harbors: Atmospheric Electricity as observed at hundreds of stations; Optical Phenomena, such as solar halos, lunar halos, mirage and rainbows; Miscellaneous Phenomena, such as the beginning of harvest at numerous points, ripening of fruits, blooming of flowers, flight and appearance of insects, polar bands, sunsets, meteors, earthquakes, etc.

The most interesting features have been: First, the few storms reported at sea; second, the unusually large number of tornadoes occurring the first ten days of the month; third, the general diminution of grasshoppers and locusts, and the slight amount of damage done by them as compared with the several years previous. This is a most interesting and valuable work, and should be made far more accessible to the public than at present in order to accomplish a tithe of the good that it ought to do.

OLIVER DITSON & Co., of Boston, who also have branch houses in New York and Philadelphia, seem to lead all other musical establishments in the production of popular pieces. They have recently sent us the following songs: "The Dust of a Rose," by J. R. Fairbank; "Little Jack Frost," a piquant little thing, by Mrs. Carleton, and "I Can't Sing for Gold," by McCarroll, which abounds in beautiful sentiments and excellent music. Also three instrumental pieces entitled respectively, "Little Bells," or "Gustav's Glockchen," by Koelling; "The Czar's March" and "Out in the Green," of which we prefer the first, although all are sweet and attractive.

ELECTRICAL CONDUCTION, by R. C. Kedzie, Professor of Chemistry, State Agricultural College, Lansing, Mich., pp. 8.

This little pamphlet consists of a series of very ingenious and apparently satisfactory experiments, made to test the question whether electricity passes by the surface alone or through the whole substance of the conductor. Prof. Henry, of the Smithsonian Institute, having decided that galvanic electricity passes through the substance and atmospheric electricity by the surface, Prof. Kedzie proceeded to make sundry experiments which can hardly be described without illustrations, but which resulted in proving to his satisfaction "that the conduction of electricity of whatever name is through the mass of the conductor and not by surface action, such as is exhibited in the statical condition of electricity," which accords with the belief of the mass of eminent electricians of Europe and America.

MR. DARWIN ON THE FERTILIZATION OF FLOWERS, by Thomas Meehan, Phila, Pa.

This is a critical dissertation upon Darwin's "Cross and Self-fertilization in the Vegetable Kingdom" and "The Fertilization of Orchids by Insects," reprinted from the *Penn Monthly*, in which the writer, from various experiments and numerous observations concludes that "there is infinitely more self-fertilization among flowers than the advocates of insect agency have of late years been contending for; that cross fertilization as developed to advantage by Mr. Darwin's artificial experiments is an almost impossible occurrence in most cases in nature, and where it must and does occur the fact is capable of a very different explanation.

REMOVAL OF HARDENED SECRETIONS FROM THE NASAL PASSAGES, and A SIMPLE MODE OF CLEANSING THE NASAL AND PHARYNGO-NASAL PASSAGES, by Thomas F. Rumbold, M. D., St. Louis, Mo., reprinted from the *Chicago Medical Examiner.*

Both of these articles are eminently practical and deserving of a wide distribution. The subject of catarrh has never been very thoroughly understood, and anything tending to elucidate it and render the disease amenable to rational treatment should meet with a hearty welcome from both patient and practitioner.

THE LIBRARY TABLE, Vol. III, No. 9, H. L. Hinton & Co., New York; weekly, 16 pp. quarto; $3.00 per annum.

This consists of book notices, literary gossip and reviews, and is a very readable and valuable periodical. One of its novelties is that the names of the writers are all signed to their articles. The last pages are devoted to an index of magazine articles, made up from the various periodicals of Europe and the United States, and a record of new books.

MONTHLY REPORT OF THE KANSAS STATE BOARD OF AGRICULTURE, for July, 1877, by Alfred Gray, Secretary, containing reports of Condition of crops and farm animals, Fruit crops and supply; Crop reports of acreage by counties, Dairy products, Garden products, Wheat market, Fish culture, etc., etc. We have before referred to this report as a very valuable one for the people of Kansas and are glad to see that its interest is fully kept up.

THE AMERICAN JOURNAL OF MICROSCOPY AND POPULAR SCIENCE, published monthly in New York, by the Handicraft Publication Co., has been sent us, with all the back numbers of this year, and we gladly welcome it as an exchange. It is a sixteen paged octavo, illustrated, and will be found a useful and entertaining magazine to those interested in the subject of microscopy. 50 cents per annum.

BANCROFT'S MESSENGER, July and August, 1877. A. L. Bancroft & Co., San Francisco, Cal.

This is a bi-monthly publication intended partly as a medium of intelligence concerning literary subjects, such as new books, music, artistic printing, etc., and partly as a means of advertising their own business.

THE CENTRAL BAPTIST, Vol. XII, No. 31, Yeaman & Ferguson, St. Louis; weekly, 8 pp; $2.50 per annum, is one of the best denominational journals in the West, and should receive the universal patronage of the Baptists of Missouri and the West.

REPORT ON PAUPERISM AND POOR LAWS in Sweden and Norway, by C. C. Andrews, United States Resident Minister at Stockholm. 32 pp. octavo.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

VOL. 1. SEPTEMBER, 1877. NO. 7.

MINERALOGY.

The Mineral Region of South-West Missouri and South-East Kansas.

BY THE EDITOR.

The recent discoveries of lead and zinc in South-Eastern Kansas having created an almost unprecedented rush of adventurous and wealth-seeking people in that direction, and the correspondents of the city papers having written them up in so extravagant a manner that the reality could but fall far short of their descriptions, the writer hereof recently made a trip to the Short Creek diggings for the purpose of satisfying himself of the actual condition of things there. (About two years since he visited and carefully examined the diggings in and about Joplin, Mo., about eight miles East).

The mineral wealth of Eastern Kansas, as developed by the building of the Missouri River, Ft. Scott & Gulf R. R., running from Kansas City to within about eight miles of the diggings, is remarkable in the extreme, and probably can hardly be equaled in the country for diversity of soil and mineral wealth, along a line so short.

Wyandotte County, besides her rich soil and a topography especially adapted for the raising of fruit, furnishes a number of quarries of white magnesian limestone, similar to the Cottonwood Falls stone; also an abundance of excellent blue limestone. Salt water has also been found in large quantities and of a strength almost sufficient, even in these days of cheap salt, to pay for manufacturing, while from the same well a natural gas forces its way out in quantity sufficient to heat and light a large city, and of a quality almost equal in candle power to the best artificial gas.

In Johnson County, which is one of the richest agricultural regions in the State, coal has been found at a depth of 530 feet, in a vein three and one-half feet in thickness, and thinner veins crop out at several points within its borders. Building stone abounds, and hydraulic cement, red ochre, fire and pottery-clay have been discovered in various localities in the counties.

In Miami County coal is found on all sides, though so far only in thin veins; the presence of petroleum is manifest in many places, building stone of the best quality and the well known "Fontana marble" abound, and recently discoveries of lead in the Southern portion of the county have been reported.

In Linn County the coal assumes a more prominent position and crops out of nearly all the hillsides and banks of streams in the Eastern and Southern portion of the county. At a depth of ninety feet a three and one-half foot vein has been struck at Barnard, where also the famous "Barnard sandstone" has been discovered and taken out in large quantities. This stone has been largely used in this city and is not only very valuable, but is also very handsome in appearance.

Bourbon County, which is probably the best in Kansas as a manufacturing district, abounds in coal of two kinds—the rusty or surface coal, which is the best for fuel, and the black or gas coal. Not less than 250,000 tons are mined in this county annually. Limestone and sandstone are also found on all sides; also hydraulic cement, fire-clay, pottery-clay and mineral paint. Lead also has been discovered in a limited amount.

Crawford County also abounds in coal, in veins running from five feet in thickness downwards, while limestone, sandstone and slate are found in abundance.

Cherokee County furnishes large amounts of coal, which is found almost universally at a depth of from ten to fifty feet and in strata varying from twelve inches to four feet in thickness. Sandstone, limestone, fire and pottery-clays also abound. Lead and zinc ores have been recognized as present for several years, but have not been, until recently, believed to exist in paying quantities. The late discoveries of these metals above alluded to have been made in Cherokee County, about eight miles North-eastwardly of Baxter Springs and, from present indications, will soon equal in importance those of South-west Missouri at Granby, Minersville and Joplin.

The counties in Missouri just across the line from those in Kansas, above described, show similar mineral developments, while on both sides of the State line the agricultural products of the several counties are fully equal to the best of any of the counties in either State, and the Missouri River, Ft. Scott & Gulf R. R. is tasked to its fullest capacity to transport the immense agricultural, horticultural and mineral productions of this territory.

The mining district of Jasper County, Missouri, and Cherokee County, Kansas, embracing jointly the lead diggings at Joplin and Short Creek, being of the same general character, may be described together, Joplin being, as far as is indicated by discoveries made up to this time, the centre of the mineral field. This whole lead region belongs, according to Professors Schmidt and Leonhard, to the sub-carboniferous system, the formation consisting of limestone and chert beds belonging to the upper part of the so-called Archimedes or Keokuk limestone. In some places the ore deposits are found overlaid by sandstone, either ferruginous sandstone or coal measure sandstone, and lie, as a rule, horizontally rather than vertically, being usually associated with silicate of zinc, or carbonate of zinc, which are rather indiscriminately called "jack" by the miners of the different diggings. Sometimes, however, it is found as "float mineral" in loose sand or clay, and not infrequently impregnating the limestone and chert, or, quite as often probably, it is found broken up and mixed with limestone, dolomite and in various conglomerate rocks.

The lead ores are usually found in the shape of Galena or sulphuret of lead, though it is common in the form of carbonate or "dry bone."

The zinc ores are found in the form of Blende or Sulphuret, and Silicate or Calamine. Carbonate of zinc is also found in connection with Calamine and, from its beautiful white and sometimes crystalline form, called by the miners "white jack."

Iron Pyrites, "the fool's gold," is also frequently found in these mines, and known as "mundic" among the miners.

Dolomite or Brown spar, usually designated as "soft tiff" to distinguish it from calcite or "white or glass tiff" and barytes, which is known as "bald tiff," forms in many mines in South-West Missouri and South-Eastern Kansas the principal gangue of the ore deposits. Calcite, calcareous spar, carbonate of lime, forms what is commonly called "glass tiff" or "hard tiff" and is frequently found in these mines. Quartz also, in crystals of pyramidal or prismatic forms is of frequent occurrence, and bitumen is frequently associated with the lead ores throughout this whole region.

The general geological section of the lead and zinc bearing formation of South-West Missouri is given by Prof. Schmidt, as follows:

a.	1 foot to 3 feet Soil. 0 to 5 feet Gravel.
b.	0 to 15 feet Sandstone. 0 to 5 feet black slate, with Coal.
c.	20 to 75 feet Chert, more or less broken up, sometimes in fissured layers, and in some localities, especially at Granby, altered to soft, porous Chert. The Chert is invariably accompanied by large masses of Clay and Sand. 0 to 20 feet Silico-Calcite. 0 to 30 feet alternate layers of Limestone and Chert.

d.. { 140 feet or more Limestone; in some places gray and coarse grained; in others bluish and fine-grained.

(*a*) Alluvium. Frequently contains some ore in loose pieces.

(*b*) Probably Lower Coal Measures, with occasional occurrences of ore.

(*c* and *d*) Upper layers of Keokuk Group. Also called Archimedes Limestone. (Sub-Carboniferous system).

(*c*) Represents the principal ore-bearing strata; (*d*) the bed rock in which no ore has as yet been discovered.

We take from the Geological survey of Missouri, 1873–4, by Prof. G. C. Broadhead, the following geological history of the region under consideration:

PERIOD OF DEPOSITION. { *First Period.*— Original deposition of the various stratified rocks, namely: The "Bed Rock," the alternate layers of Limestone and Chert, the Silico-Calcite, the Slates and Coal, and of the Sandstone.

These several strata, after their deposition, probably remained unaltered for a very long time and became dry, hard and dense before the second period began.

PERIOD OF DOLOMIZATION { *Second Period.*—Local dolomization of certain strata of Limestone. Disturbances and ruptures in the Chert in consequence of the contraction of the Limestone during the metamorphoric action. Principal deposition of the ores from watery solution.

This metamorphic action was confined to a part of the alternate layers of Limestone and Chert, and very limited in its vertical extent—rarely exceeding 20 feet.

The dolomization of the Limestone, and the simultaneous deposition of the ores, began either from horizontal crevices and then extended through the whole mass of one stratum of Limestone and was limited by the layers of Chert above and below, or it began from vertical crevices in the Limestone and formed a mass of Dolomized Limestone, with ore extending along the crevice between the Chert layers, and generally from three to ten feet wide. In the first case the "openings" of Granby were formed, in the second the "runs" of Joplin.

PERIOD OF DISSOLUTION. { *Third Period.*—Dissolution and removal of a part of the Limestone from the Silico-calcite and from the alternate layers of Limestone and Chert. Gradual breaking down of the remaining concretions and of the layers of Chert, and of the strata above. Continued deposition of ores in diminished measure.

In this period the immense accumulations of broken Chert were formed, which in so many places overlie or accompany the ore deposits. The ore (nearly always Galena) was deposited, in many places, in the fissures and little cracks of the broken Chert beds, in sheets between these layers and in crystals adhering to pieces of broken Chert, sometimes on all sides of the fragments, showing plainly that the Galena was formed after the Chert had been broken.

PERIOD OF REGENERATION — *Fourth Period.*—Local regeneration of the partially dissolved and softened Limestone by renewed deposition of Carbonate of Lime. Local infiltration of Quartzite. Continued deposition of ores.

All the conglomerates which consist of Chert-fragments, cemented either by a silicious or by a calcareous mass, the cementing mass inclosing crystals of Blende or Galena, were formed in this period.

PERIOD OF OXIDATION. — *Fifth Period.*—Oxidation of the metallic Sulphurets, and alteration of these Sulphurets into Silicates and Carbonates.

During this period the Galena, in many deposits, was more or less altered into Cerussite and Pyromorphite, the Blende into Calamine and Smithsonite, and the Pyrites into Limonite. Some of these minerals also, while in solution, were carried over larger or smaller distances and re-deposited as seams or impregnations in Sands, in Clays or in Chert Breccia.

The local corrosion and partial dissolution of the Chert, and its alteration into a porous and more or less friable mass, must have taken place after the deposition of the ores. This is proved by the entire absence of ores in the porous Chert. This corrosion, therefore, belongs to the Fourth and Fifth Periods, and probably continues to the present day. Also, the oxidation of the ores undoubtedly yet continues.

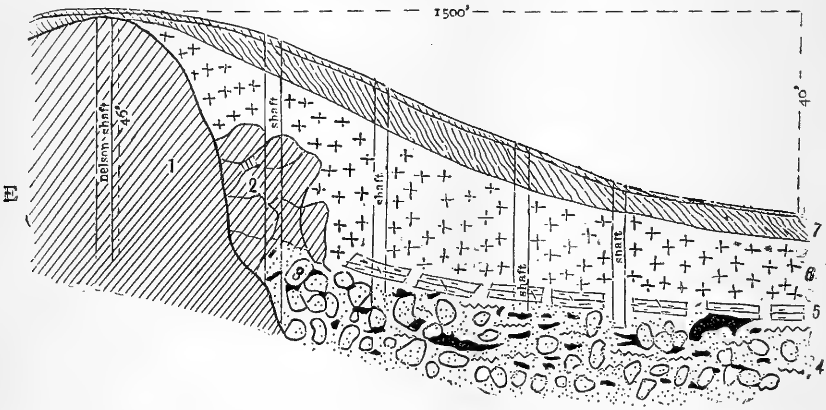
All these mechanical and chemical actions which, according to present appearances, are confined to the upper layers of the Keokuk Limestone, have taken place over a very large area in South-West Missouri, but with different intensities and effects in different districts and localities."

The stratifications in the Joplin district are generally very irregular in their character and relative positions and often vary considerably within short distances, the succession of rocks often remaining the same for long distances but the layers being of very variable thickness and dipping with the slopes. The materials in the bottom lands seem to be principally vast deposits of sand, drift and chert, with occasional masses of Galena, known as "float mineral."

Owing to the exceedingly disturbed condition of the geological formations, it is almost impossible to form any opinion as to the existence or non-existence of lead or zinc ores from any surface indications, any previous experiences as a miner, or from any scientific teachings in the schools or other mining regions, even in the same State.

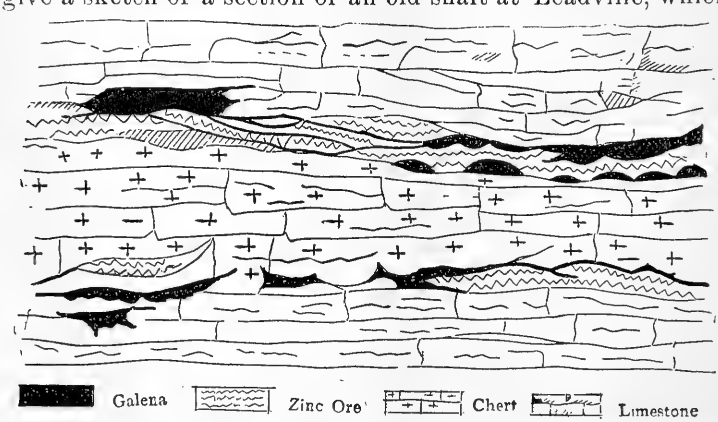
In the Joplin district the ore deposits are mostly to be found in "runs," usually from one to five feet in thickness, extending horizontally between layers of chert above the bed-rock Limestone, marked (*d*) in the table on page 387, though, as before stated, it is sometimes found as "float mineral" in the clay diggings.

We give below a cut showing a longitudinal section of a run at Swindle Hill diggings, near Joplin, among the most productive of any in the whole region, by an examination of which the disappointed miner can at once see how it may happen that he may spend his time and money unavailingly, while his nearest neighbor may be very successful.



No. 1 represents the solid or bed-rock limestone, projected to within a few feet of the surface; No. 2, rotten limestone; No. 3, rotten sandy limestone boulders; No. 4, run of ore, with both Galena and zinc blende among the boulders; No. 5, broken chert layers, capping the run; No. 6, loose broken chert; No. 7, clay. This may be regarded as being as nearly a representative or typical lead mine of the Joplin region, as anything that we can give, and the miners of that region will at once recognize it as such, though, of course, mines are different in details. Going westwardly from Joplin, the same general geological formation prevails and the miners at Leadville, Mo., and Short Creek, Kansas, experience much the same difficulties in mining and meet with about the same degree of success.

We give a sketch of a section of an old shaft at Leadville, which is but



about three miles from the Short Creek mines, and may be regarded as a fair representation of the condition and position of the lead and zinc ores in both localities.

The only general conclusions to be derived from a study of these mining regions seem to be that digging in bottom lands for "float mineral" is a very uncertain thing; that sinking shafts into or below the bed-rock limestone is useless; and that the principal ore-bearing stratum is composed of chert, clay and sand, the metamorphic conglomerate mixture of chert and limestone and the alternate layers of chert and limestone, all of which are usually immediately above the solid bed-rock limestone formation.

The city of Joplin, Mo., is well built, healthful and contains a population of about 8,000 people, whose support comes principally from the lead and zinc industry.

The towns of Galena and Empire City, rival places on opposite sides of Short Creek, in Kansas, have, within a few months, attained a population of some two thousand or three thousand people, and are growing rapidly. Among the best mines in these diggings are the "Labette," Robinson & Co., on the lands of the South Side Mining Co.; the "Blackwell" shaft, Blackwell & Co., on the Empire lands, north side of Short Creek; the "Discovery" shaft, McPherson & Co., on Empire lands, south side of Short Creek; Harper & Co. shaft, one of the best paying on Short Creek; "McBratney & Mitchell" shaft, S. S. Mining Co.; and the "Nevada," Cummings & Co., all of which are located on the bottom lands, except that of McBratney & Mitchell and the "Nevada."

The amount of lead taken out of Joplin annually amounts to many millions of pounds, while even at Short Creek it reaches from 200,000 to 300,000 pounds weekly. At the latter place great activity exists, hundreds of shafts having been sunk on both sides of the Creek, and above and below Galena and Empire for several miles, while prospecting is progressing energetically in every direction. At the Bonanza diggings a smelter is in full operation, while another is nearly finished just below Galena. Large amounts of mineral are being taken out at various points, both on the uplands and in the bottoms. Last week Mr. Cummings struck a rich vein of Galena, said to be from six to eight feet thick, in the "Nevada" mine, South side diggings, and took out about 2500 pounds in one day. Several other good strikes were made about the same time, near the same locality, and if these "finds" indicate anything, it is that the diggings in the direction of Joplin are the most promising. This idea has gained ground rapidly, and has greatly stimulated work in that direction of late, and also on Shoal Creek.

Other mining camps are being settled in the vicinity of those already described, at Webb City and other localities, and the zinc works at Cherokee, Kansas, are being remodeled and enlarged, by gentlemen of abundant means and enterprising dispositions, and it is believed that but a few years will elapse before the region of South-west Missouri and South-eastern Kansas will be the centre of a vast manufacturing interest and furnish homes for hundreds of thousands of busy and thrifty artisans, laborers and farmers.

THICKNESS OF THE MISSOURI COAL MEASURES.

BY PROF. G. C. BROADHEAD.

In a volume published by its author, S. A. Miller, in Cincinnati, 1877, we find the following table of thickness of coal formation in various fields:

Nova Scotia	14,570	feet.
Pennsylvania	8,000	"
Tennessee	2,500	"
Ohio	2,000	"
Illinois	1,200	"
Missouri	640	"
Kansas	2,000	"
Nebraska greater than last.		

It is a great pity that Mr. Miller, in making up his figures, did not consult the latest authority. If he had written to me it would certainly have afforded me very great pleasure to have made out a careful statement for his use. Under the circumstances we feel that justice has not been done to our State. Here in Missouri we know his figures to be wrong. Prof. Swallow, in his geological report of Missouri for 1865, from preliminary examinations, makes our coal measures 640 feet thick. This is where Mr. Miller obtains his figures. Since then, Swallow, myself and others have made more extended and careful investigations, and found our measures to be much thicker.

In such a useful work as that of Mr. Miller's, we regret very much that he has not the later and more correct figures; for these appear comparative with those of other districts, and may be read afar off and regarded as authority.

In 1873 Prof. Swallow, with Campbell's map of Missouri, published a later geological sketch of Missouri, in which he says:

"We have observed about 2,000 feet of coal measures in Missouri."*

During the year 1859, 1860 and 1861, whilst acting as assistant on the first geological survey of Missouri, much of my time was occupied in examinations of the coal measures, particularly the Upper measure of Missouri. From notes then taken I prepared a careful section of the coal measures, and found the Upper measures to be 1,284 feet thick. At the same time I obtained from other observers of Missouri geology data from which I calculated the thickness of the Middle Coal Measures in North Missouri to be 300 feet and the Lower measures 500 feet, or a total of coal measures in Missouri of a little over 2,000 feet thickness. The result of these notes was the publication by myself, in 1865, of an extended paper, with a complete section on the Coal Measures in the transactions of the St. Louis Academy of Sciences.

*Dana's Manual of Geology, 1874, gives 2,000 feet.

In 1872 I carefully re-examined the Upper Coal Measures of Missouri, revising the field work of nearly all my previous sections, and constructed an entirely new section. In this I found the observed sections to foot up 1,267 feet of Upper coal measures. To this should be added not over 40 feet for a break in the connection in Atchison and Holt counties, and we would have a little over 1,300 feet for the total thickness of the Upper Coal Measures, differing not over 20 feet from my former work, all resulting from a careful comparison of several hundred different sections.

The Middle and Lower Coal Measures differ somewhat in thickness in different portions of the state. My section of the Middle Coal Measures of North Missouri made in 1872 make them 323 feet thick. Observations in 1871 along the line of the Pacific Railroad in Johnson County make the Middle Measures 327 feet and the Lower Measures 290 feet.

In 1873 examinations in South-West Missouri made the Lower Measures in those counties about 300 feet thick and the Middle Measures over 300 feet in thickness.

METEOROLOGY.

The Connection Between Storms and Sun-Spots, with Record of the Celebrated Storms of 1600 Years.

BY COL. HENRY INMAN, OF KANSAS.

This year has been, in the United States, one of severe and remarkable storms. Their rapid succession and destructive results has provoked popular comment, and created serious alarm. This series of terrible atmospheric disturbances, which in nearly every instance have been unprecedented in their grandeur and destruction, invites the suggestion that there must be some special influence to account for the apparently exceptional meteorological phenomena of this season. It has prompted an examination of the dates of some of the most remarkable storms that have occurred in the last sixteen hundred years—a partial list of which is here presented. If a complete record were possible of all the violent storms of historic times, an investigation of all the data in reference to their cause would undoubtedly develop the fact that the remarkable atmospheric disturbances of the present season should not be regarded as anomalous, but have been manifested in strict obedience to a law or complication of laws, that themselves recur, and with them their accompanying phenomena, in cycles whose period is a constant number. It will be observed by a careful comparison of dates, that the most violent and destructive storms of record meet the requirements of the hypothesis (of the principle of which, further on). It will also be observed that the great storms to which reference is here made, or at least a large proportion of them, have extended over areas fully equal to any that have visited this continent the present season. Unquestionably the disturbing cause this year is the same as that in the years of the greatest frequency of remarkable storms that have passed. Lightning the most vivid, thunder the most deafening, and earthquake shocks characterized the terrible storms of history, as they have been the prominent features of this year's meteorological record, pointing conclusively to the fact that they have been, and are at each returning cycle, magnetic in their origin.

The cause of these periodical years of violent storms, it is conceded, is clearly due to the unusual magnetic activity of the earth at that time and the dependence of this upon the sun's condition as to the areas and number of spots. The phenomena of their increase and gradual decrease through constant periods has been established by the untiring daily observations of the celebrated German astronomer, Schwabe, (covering nearly thirty years), and the confirmation of his discoveries by other eminent observers. Schwabe found that the solar spots increase in magnitude and frequency for about five years and a half, and decrease through an equal period, completing the cycle in about eleven years. Professor Loomis in one of his recently published works—"an Analysis of the Observations of many years,"—shows conclusively "an existence between the sun-spot period and the intensity of terrestrial magnetism." It is subject to proof that the meteorological disturbances under consideration are purely magnetic, the effects as we see them purely local, and not universal but erratic. These magnetic variations, the results of which are violent storms on the earth's surface, were once considered fitful—their cause having been suspected, but not believed periodical—are equally with other distinct natural forces cosmical in their character. Lesser cycles than that of eleven years have been suspected by some observers, and a long one of fifty-six years due to the conjunctions—successively of Saturn and Jupiter. The theory of Professor Tice is of the same nature, relatively, and the disturbances which he ventures to predict are magnetic in their causes, but based upon the distinct effect of the planets, successively, on the earth at their equinoxes. His theory, in a measure, must be correct and in accordance with now known laws, but whether his predictions as to precise localities and exact dates are not rather the result of too great an enthusiasm, will admit of discussion. We are now approaching the period of maxima of sun-spots, (1879), and also the fifty-six-year period, (1884), and may expect all the fury of its attendant phenomena for the next ten years, with a culminating force at the latter date, unless, as believed by LaPlace, there is always some compensatory law which interferes at the proper time to readjust any impending clash. An attempt has not been made to record all the great storms of history, the difficulties of gathering such a list being obvious. But sufficient data, both ancient and colonial, has been examined to prove that so far as remarkable seasons are concerned, this is no more so than hundreds of others that are buried in the mighty past—that the years, or periods of sun-spot, actually, taking them one with another for centuries, have been just as fruitful of violent storms as the present one, and that the solar radiation has not materially differed from its present intensity, increasing and decreasing at regular intervals only, it recurring maxima and minima affecting the earth as its meteorological history has shown and we have experienced in our own time.

In A. D. 234, a terrific cyclone visited Canterbury, England, that threw down two hundred houses and killed a number of families. In 277, a violent tempest raged at London, destroying many lives and much property. At Winchester, in 301, a destructive hail storm passed over that place, during which hailstones fell that were larger than hen's eggs. In 420, during a severe storm at Carlisle, a number of houses were blown down, and a great many people killed. In 349 a terrible hail storm extended over the greater part of Britain, killing many people and large numbers of cattle. In 459 a most destructive storm visited London, which destroyed hundreds of houses and killed two hundred and fifty of the inhabitants. Another in Lincoln in 701 blew down over one hundred houses. At Cambridge, in 919, forty houses were destroyed in a tornado. In London again, in 944, fifteen hundred houses were blown down by the force of the wind. In 1055 London was revisited with another terrible storm, and four hundred houses were demolished. On the 5th of October, 1091, a violent storm extended over the whole of England, carrying terrible devastation in its course, but was especially severe in Gloucestershire, where it destroyed all the churches and many other buildings. On the 17th of the same month, in the same year, a storm passed over London, throwing down fifteen hundred houses and unroofing Bow Church. In 1194 a violent storm almost desolated a great part of Denmark and Norway; many lives were lost and houses overthrown; the grain in the fields was destroyed by hailstones as large as hen's eggs. It thundered and lightened for fifteen consecutive days, with a succession of terrible tempests. In 1233 the chimney of the chamber where the Queen of King Henry III and her children lay was blown down, and the whole apartments at Windsor shaken. This storm was accompanied "with such thunder and lightning as had not been known in the memory of man.". In 1251, as King Edward I and his Queen were talking together in their bed-chamber, a flash of lightning struck in at the window, passed by them, killed two of their servants present, but did their majesties no harm. In 1285, when Edward III was on his march, and within 84 miles of Chartres, "there happened a storm of piercing wind that swelled to a tempest of rain, lightning and hailstones, so prodigious as instantly to kill six thousand of his horses and one thousand of his best troops." In 1479 a storm passed over Huntingdonshire, in which the hailstones measured eighteen inches in circumference. In 1510 a storm of fearful violence in Italy "destroyed all the fish, birds and beasts" in an immense area of country. On new year's day, 1515, a terrific storm in portions of Denmark rooted up whole forests, and blew down the steeple of the great church at Copenhagen. In the same year, and the succeeding two years, terrible storms occurred in Northamptonshire, in which "the hailstones measured from seven to fifteen inches around." On the 3d of September, 1658—the day that Cromwell died—a most terrible and destructive storm extended all over Europe. In 1696, during a fearful storm in the Bay of Cromer, two hundred vessels, with all their crews, were lost. In the same year, April 29, a hail storm raged at Cheshire, Lanconshire, and other parts of England, that killed fowls and knocked down horses and men. On the 4th of May, in the same year, in Herefordshire, hailstones fell that measured fourteen inches in circumference, "destroying trees and green fields in a terrible manner." One of the most fearful that ever occurred in England—November 27, 1703, unroofed hundreds of houses and churches, blew down chimneys and steeples, and tore whole groves of trees up by the roots. "The leads of large buildings were rolled up like scrolls of parchment, and several boats and barges were sunk in the Thames." The royal navy suffered the greatest damage. It had just returned from the Mediterranean, and "one first rate, one second rate, four third rates, and four fourth rates were wrecked, and over fifteen hundred sailors lost." A large number of merchant vessels were also lost. In the city of London the damage was estimated at five millions of dollars. The Carolinas were terribly devastated by storms in the months of August, 1722–8. At St. Kitts twenty ships were lost. On the 30th of June, 1733, at the mouth of the Ganges, in India, a most fearful storm destroyed twenty thousand vessels of all kinds, among which were eight East Indiamen. In this storm three hundred thousand lives were lost. The tide rose forty feet higher than usual. Another at Nantes occurred on the 7th of March, 1741, when sixty-six vessels and eight hundred sailors were lost. On the 10th of August and 8th of December, 1751, during severe storms at Cadiz, and on the South Carolina coast, shipping was destroyed to the value of three hundred thousand dollars. In a storm at Girginti, in Italy, on the 4th of May, 1761, "the hailstones weighed a pound and a quarter and did immense damage." On the 18th of April, 1772, at St. Iago, "hailstones fell as large as oranges." On the 16th of July, of the same year, a terrible tempest raged at St. Kitts, which devastated that and adjoining islands. On the 30th of August, the same season as the above two terrible storms, a fearful tornado visited Boston. In July, 1773, fearful storms occurred in Cuba, and Algenon, in France. The hail was awfully destructive, the hailstones measuring six inches in diameter. Antwerp, and other places in Holland suffered from a severe storm on the 3d of August, 1774, when the hailstones weighed nearly a pound, which killed horses, cows and other animals, and totally destroyed the growing crops. The whole of the West Indies was visited again on the 11th of June, 1776—one of the most severe storms ever known. Another storm occurred at Jamaica on the 6th of September, of the same year. Over the whole of England a most terrific storm raged for three days in January, 1779. Madeira was the scene of a fearful storm on the 26th of July, 1782. Thirty thousand dollars worth of glass in the windows was destroyed—some of the hailstones weighed a pound. Surat, in the East Indies, had several thousand of its inhabitants killed in a violent tornado on the 22d of April in the same year. Dienpole, in Moravia, was totally destroyed by a storm on the 30th of May of the same year. On the 17th of June, of the same season, immense damage was done all over America, particularly on the New England coast. On the borders of France and Spain, in 1784, hailstones fell during a series of storms that weighed nearly a pound and a half. One hundred and thirty-one villages and farms were laid waste in France on the 5th of August, 1785. A terrible tempest raged in the English channel in July, 1786, and many large and small vessels were lost. Ferrara, in Italy, was visited by a terrible hail storm on the 17th of July, of the same year. This storm apparently extended over a part of England. At Highlickington, in Devonshire, on the same day, thirteen large elm trees were removed nearly three hundred yards from the original spot and remained standing in a flourishing condition. At the same time and place, a large rock was torn in two and the pieces separated eight feet. All the poultry and grain for miles in that region was totally destroyed by the thunder and lightning. In 1786–7 hail storms were general all over England and in the West Indies, particularly in the Bench Islands, where the destruction of property was terrible. On the 13th of July, 1788, at St. Germain en Laie, in France, hail fell as large as a quart bottle. All the trees from Valance to Lisle were torn up by the roots. This storm extended over the whole kingdom and did immense damage. On the 23d of December, 1790, another terrific storm raged all over France, carrying devastation in its path. In September, 1791, a violent hail storm fell in Calatria, near Naples, where the hailstones weighed a pound and destroyed all hopes of a vintage. In October, of the same year, during a fearful storm, the Church of Spildhurst, in Kent, was destroyed by lightning, the bells were melted, and other damage to the town sustained. In March, 1793, a terrific storm visited Sussex—the hailstones were four inches in circumference. At Whitehaven this storm did great damage, and the tide rose six feet above its usual height. In August, of the same year, hailstones fell at Thornton, in Liecestershire, that measured six inches and a half in circumference, doing immense damage. On the 2d of June, same year, a fearful storm visited Jamaica. On the 16th of July, 1794, an almost universal storm in Great Britain caused devastation in its track. In the Barracks, at Bletchington, nearly a thousand panes of glass were destroyed, and other damage done. On the 25th of September, 1798, a terrible storm visited Halifax, and half a million dollars worth of property was destroyed. On the 19th of August, 1800, irregular pieces of ice fell in Oxfordshire the size of hen's eggs The same storm did great damage in Bedfordshire, where hailstones fell eleven inches in circumference, killing all the partridges and hares, and destroying all the grain in the fields. On the 8th of November, of the same year, great damage was done in London again, and throughout all England. In November, 1801, a terrible storm visited the whole of North of England.

On the 18th of August a violent hurricane of wind did great damage in Devon and Cornwall. This same storm blew down a stone wall at Sherfield-place, three hundred feet long. Two days afterwards a dreadful storm occurred at Kingston-upon-Thames (probably the same storm). On the 6th of July, 1805, a terrific thunder storm passed over Somersetshire, when the hailstones measured seven inches in circumference. Boston was visited by a dreadful one on the 15th of July, 1808, in consequence of which, and the abnormal rising of the tide, the town and country round was deluged. On the 10th of November, 1810, at Iffley, near Oxford, ten barns, some out-houses and thirteen large stacks of hay and grain were destroyed. (This damage seems to have been the result of a waterspout, as it was confined to one farm—a Captain Nowel's). On the 12th of October, of the same year, at Eaton Locon, Bedfordshire, a heavy storm of thunder, lightning and hail occurred, during which an immense ball of fire fell, and a barn, malting office and stable were burned down. On the 13th of October, 1813, a tremendous gale and storm prevailed all over Great Britain and Ireland, doing considerable damage in many places. For two days, December 16th and 17th, 1814, a violent thunder storm raged in London. A dreadful storm burst upon the town of Worchetz, in the county of Timeswrr, on the 2d of July, 1816, where out of two thousand six hundred buildings, none escaped injury. On the 13th of August, in the same year, a fearful storm raged on the English coast, in which much shipping was lost. Liverpool, Birmingham, Manchester, and other towns experienced a tremendous gale of wind on the 27th of February, 1818. Three hundred and fifty hurricanes were recorded on the Atlantic coast between the years 1493 and 1855. Many, of course, have occurred since the latter date. The hurricane of August, 1823, in which over one thousand vessels were lost, and that of October of the same year, as well as the fearful one of February, 1824, one fresh in the memory of the people. The years 1868–9, one of the periods of greatest sun-spot frequency, were fruitful of violent storms all over the world, particularly in the United States. In a revised list of all the hurricanes on the Atlantic coast, from the earliest historic date to November, 1873, published in the Paris *Comptes Rendus* for that month, is shown the comparison between the years of the greatest number, and most destructive hurricanes, and the years of the largest number of sun-spots. It is remarkably confirmatory of the theory now generally accepted: That the variations in solar heat produce a similar variation in the terrestrial evaporation, and an increased tendency to violent storms.

ZOOLOGY.

THE PEABODY MUSEUM, YALE COLLEGE.

The original gift by the late George Peabody was $150,000; of this sum $20,000 is to be entirely reserved until it amounts to at least $100,000, when it may be used for other parts of the whole edifice. A sum of $30,000 is also reserved to provide something toward an income for the maintenance and care of the Museum.

After $20,000 and $30,000 had been thus set aside from the fund, $100,000 remained for the erection of the present building, and that sum was invested with such judicious skill that its total was finally raised, in the course of about ten years, to $176,000. The executive officers of the board to whom this trust was confided, are Profs. J. D. Dana, G. J. Brush and O. C. Marsh.

The Peabody Museum is of brick, with stone trimmings. It is practically of five stories, since both the basement and attic are high and well lighted. The present structure consists of a main building and a wing; the roofs are lofty and pinnacled. In the design the building is not severely simple, yet it is not overloaded with ornament; in this particular, both as to details and general outline, the happy mean is struck. The architect is Mr. J. C. Cady of New York.

In the Peabody Museum no pains have been spared to put the exhibition on easy terms with the public, so that a person of fair average information passing attentively through the rooms, will be instructed as well as gratified by even a hasty survey. The collections are systematic, and they are arranged systematically. The first floor is devoted to mineralogy, except as to the space taken for a fine lecture room; the second floor to geology, including fossils; the third to osteology and general zoology; the fourth to archæology and ethnology.

Without intending any disrespect to the footprints, the precious stones, the mammoth, the six-horned dinoceras, or even the birds with teeth, the curiosity-seeker may for the moment pass them by and begin with the third story, where are the specimens of zoology, the life of the present day. Of course the subsequent proceedings will be somewhat undignified if the start is made at the top of the ladder, but the human race should be always the first to claim our sympathies. Since the proper study of mankind is man, it is well to begin here with the case nearest the door, labelled "Primates." There they stand in a row, in just the condition that Sydney Smith wished for in hot weather—with all the flesh removed from their bones. And now—how shall I state it tenderly without giving offence?—the Primates of science, unlike those of the Church, include, with man, the monkeys; and looking down the row of skeletons and skulls, it is not easy to say at a glance where man ends and ape begins. There are skulls with lofty foreheads that look like the dome of thought, but unfortunately they belonged to chimpanzees; while other skulls, with low crowns and scarcely any forehead, once held the brains of some Indian chief or South Sea Islander. In this display of anatomy woman holds the place of honor, the finest of the skeletons of the human race being that called by the disrespectful attendants of the Museum, the "Chicago Girl." Her figure was tall and admirably proportioned, but the special interest which attaches to her skeleton is that she possessed an extra pair of ribs, or rather riblets, attached to the seventh cervical vertebra. Ordinary mortals are not thus provided with a spare rib; perhaps Adam was in his younger days. The "Chicago Girl" might have been an adept in dancing, for in both feet the bone on the inside of the elevation of the instep, which in ordinary skeletons is a single bone, with her is of two pieces, doubtless giving additional flexibility. Compared with this young lady, the bones of a Chinaman (21 years of age) standing alongside, show a feebler frame. From the well-known custom of the Chinese of carrying the corpses of their deceased countrymen back to the homes of their ancestors, skeletons of that race are among the most difficult to obtain; but the Museum is rich in Asiatic bones, and has one of the finest collections of Chinese and Japanese skulls in the world. It seems to be the general rule with the specimens throughout the Museum that each of them is rare, peculiar, or hard to match, and many of them are consequently of high value. Every known species of some of the rarer groups is here represented. Among them are the anthropoid apes, orangs, gorillas and chimpanzees old and young, and of each sex; and numerous brain casts, as well as skulls, that will afford food for thought not to the anatomist only, but also to the metaphysician. Other museums considered themselves enriched by a single skeleton or even a skull of a gorilla, and few are so fortunate; here there are half a dozen skeletons of that animal, and also many of its skulls; the other man-like apes are even more fully represented. But it is time to notice the systematic arrangement of the osteological specimens in this room; it is as follows:

Primates: including men, monkeys and lemurs.

Carnivora: including bears, hyenas, tigers, cats, dogs, etc.; also, the sea otter, wolverine, walrus, seal, etc.

Ungulates: divided into Artiodactyls or even-toed animals, such as goats and sheep, deer, antelopes, bovines, camels, various swine, etc.; Perissodactyls or odd-toed animals, such as the tapir, rhinoceros, and a complete series of the equine group; Probiscidians and Hyracoidea, a case where extremes meet, as the one sub-division includes the elephant and the other the hyrax or coney.

Rodents: such as rabbits, squirrels, beavers, and all kinds of rats and mice.

Cetaceans and Sirenians: such as the whale, porpoise, dolphin, manatee, dugong.

Edentates: such as the armadillo, ai, sloth, ant-eater.

Marsupials and Monotremata: such as the opossum, kangaroo, duck bill, (ornithorhynchus).

Birds: land, water and struthious; the last including the ostrich, emu, rhea, cassowary and apteryx.

Reptiles: crocodiles, lizards, snakes, turtles.

Batrachians: frogs, toads, salamanders.

Fishes: survivals of old forms, such as the gar-pike, amia, sturgeon; also the shark tribe and Teleosts or modern fishes.

Thus by a series of existing animals, none of the extinct races being here introduced, the student may see something of the relationships of structure all the way from fish to man. All the quarters of the earth have contributed to fill this series, and neither pains nor cost have been stinted to obtain the rarer types that complete the intervals. These specimens are peculiarly valuable to investigators who are tracing the order of descent of man. With this view, the case of Primates contains a series of pre-natal skeletons of the human species, which have already occupied a popular designation of the Museum as the "Infant Class;" and in general the younger forms of animals have been liberally provided, as these throw great light on the theory of descent from ancient types. The series of the existing horse family is fully presented; this is also true of the rhinoceros and of other groups. Of course such complete results throughout the range of Natural History have only been obtained by sharp and prompt competition with foreign museums, as to purchase; and also, by employing collectors in the ends of the earth and on every continent. There are so many curiosities worthy of separate mention that they cannot be even referred to here; but the visitor is not likely to miss the elephant's tusks cut so as to show where bullets had been imbedded and afterwards overgrown with ivory; a large elephant's skull sawn in two parts, showing how small a proportion of it was occupied by brains; or the "Baby Elephant," which was born in Barnum's menagerie; and it would be difficult to overlook the Rocky Mountain goats, old and young; or the gigantic salamander of Japan, which is fully a yard long. Several of the specimens, indeed, require more room than can be furnished under glass, and occupy the centre of the room—among these are the great walrus from Alaska, and some of the larger bones of a whale. Here two horse skeletons afford a remarkable contrast. One was the diminutive Shetland pony that spent the greater part of a long life in giving brief happiness to thousands of children at Barnum's exhibitions. The other illustrates the highest development of the horse, showing even in the skeleton the noble quality that was bred in the bone. This animal was the famous Arabian mare Esnea, imported along with Saida. When Mr. John W. Garrett, president of the Baltimore & Ohio Railroad, purchased her, he had to outbid Louis Napoleon. The Arab keeper, to whom she was accustomed in Syria, accompanied her to this country. She died a few months ago of a lung fever when 27 years old; her offspring are numbered at thirty-nine or forty. Mr. Garret very recently presented the skeleton to the Museum.

The whole osteological collection is three or four times larger than the portion displayed. It was in great part made by Prof. Marsh, and largely at his own expense, with a special view toward facilitating the comparison and study of fossil remains. Mr. George Bird Grinnell, who was with Prof. Marsh on some of his expeditions, and with Gen. Custer on the first entry of the Black Hills region, has been appointed by Yale College as Professor Marsh's assistant in osteology. Mr. Grinnell has rendered important services in arranging this collection, and it will remain under his immediate care.

The remainder of this room, as well as the rest of the third floor, is devoted to zoology. Of this department Prof. A. E. Verrill is curator. There is here a systematic collection of vertebrate animals, including fishes, presented in their external forms—some stuffed, some in alcohol. Here, as elsewhere in the building, the specimens are among the best or rarest of their kind, and those which illustrate the relations between separate groups of animals are especially to be found. Such, for instance, as the dipnoi or double-breathers among fishes, having both lungs and gill. These are represented by the lepidosiren and the ceradotus, the latter as far as the teeth are concerned, almost exactly similar to the ceradotus of the triassic epoch —a very distant one in geology. The fact that this animal has been found living in Australia, and that the changes in form of the teeth, if any, have not been important, is one of the most remarkable in modern discovery. The survival of its race through the long series of changes in the earth's crust since the trias, shows that whatever may have been the upheavals and subsidence of the earth in the great interval, no complete destruction of life throughout the globe has taken place. Even though the pre-glacial man should be discovered, the antiquity of the human race must be regarded as that of a day-fly compared with the ceratodus. On the top of the cases on this side of the room other strange fishes are mounted ; these are principally of the shark tribe.

The invertebrate life of the present day is also presented in the west room of this floor, in similar systematic arrangement. There is a good collection of insects, showing representative ones of each family, but with no attempt at exhibiting all the species. By such means the student is enabled to survey the whole field of entomology upon examining not more than a thousand insects—a bird's-eye view such as no bird has ever enjoyed. When a visitor from the prairies of the West begins to talk about grasshoppers, he is led up to view *Tropidacris dux* from Central America. This leader of the 'hoppers measures eight inches across the wings, and six and a half from tip of antenna to end of leg. The leaf-insects from India are admirable specimens of their kind ; they justify the forecastle yarn about the leaves dropping off the trees on one of the South Sea Islands and assembling in a swarm to share with shipwrecked sailors their breakfast on shore. Something ought to be said here concerning the ingenious boxes that contain the insects, the excellent arrangement of labels, and the like ; but in all such matters this Museum is beyond reproach. In another set of cases the crustaceans are displayed to the utmost advantage. Each individual crab seems ready to walk the waters like a thing of life. Prof. S. I. Smith, who is an authority on the natural history of the crabs, has devised methods for showing off his pets with all their natural grace; they are evidently as ready as ring politicians to seize plunder with claws that will not relax till they are broken, or to back down on principle at a moment's notice. The pincher claw of what was probably the "boss" lobster is thirteen inches long by seven broad, and as formidably armed as an old-fashioned rat-trap. Consider what would have been the feelings of a bather if that pincher had closed on a tender extremity—say upon a great toe. Other strange creatures of the sea are in adjoining cases—star-fish bigger than Kentucky flapjacks, and probably as tough; anemones and hydroids preserved in glycerine, and expanded in nearly all their glory of wreath and color; polypes and jelly-fishes that have resigned life suddenly when dropped into picric acid; barnacles much larger than a goose egg, and of a shape to encourage the ancient belief that wild fowl might be hatched therefrom. Another of the old traditions of the sea, the story of the Kraken, which could throw out his long slimy arms around a vessel and drag it down beneath the waves, turns out to be true, since this very attempt was made upon a boat off the Newfoundland coast by an immense cuttle-fish; and here in the Peabody Museum are the arms of such a sea-monster, preserved in alcohol, and evidently not wanting in length or strength for such performance.

As representing the sea life of the New England coast the collection is quite complete, having rare and in many instances type specimens obtained in dredging expeditions by Profs. Verrill and S. I. Smith and the U. S. Fish Commission. Especially is the selection of fine specimens apparent in the corals and sponges, many being "uniques," that is, the only ones of their kind ever discovered. Both coasts of this country are here well represented, and the magnificent corals of the Wilkes Exploring Expedition contribute largely to the show. Prof. James D. Dana (the geologist), accompanied the expedition, collected many of the finest of these specimens, and wrote a standard work on that branch of zoology, Even the casual visitor cannot pass some of these great corals without a feeling of admiration for perfect development of form or color; such for instance as a meandrina (brain coral), exactly dome-shaped, and more than four feet in circumference, or the gorgona corals, having the form of miniature forest trees and rich in the highest tints of autumn foliage—varied combinations of red and yellow of every possible shade. To several of these an individual history is attached, well worth the telling, but space presses. When a visitor talks of the minute "coral insect" to Prof. Verrill, he is shown a gigantic one—a single animal eighteen and a half inches long and seven and a half wide—and reminded that the term "insect" is a sad misnomer. The beautiful "glass sponges" are here in great variety, cornucopias of woven glass with lace fringes and lid, and showing the fibres at the base, by which they were once secured to the sea-bottom. There is here an elegant "Neptune's cup," which is 6½ feet in circumference and $2\frac{1}{2}$ high—a goblet worthy of the Sea-God. Besides the general collection of marine animals, there are three separate collections which are special in their character. These are, one from the New England coast (already alluded to); one from the Pacific coast, complete, from Behring's to Magellan's Straits, and one equally complete from the coasts of our Southern States. In general it should be said that the completeness of the collections from the coasts of the United States is one of the most satisfactory features of this Museum.

Each of the floors has its own proper laboratory and working rooms, well appointed, and in constant use by the professors in the department to which the floor is appropriated.

From the creatures that are now existing on the globe to those that perished in by-gone geological epochs thousands of centuries ago, is in this Museum only a step to the lower story. The "vertebrate fossils" have a room to themselves, and even when the choicest of them are picked from Prof. Marsh's abundant collections, they will more than fill the space assigned. Already in the cases intended for mastodons and fossil elephants, the great bones of the Otisville mastodon have crowded out all else. The bones produce the impression of great size, and spectators view them with apparent awe. The enormous teeth and jaws are complete; the skull is $3\frac{2}{3}$ feet long; the great arch of the pelvis is 5 feet across, and still bears the mark—now historic—where an inquisitive countryman poked it with his cane, just to find out how hard the bones were. It is the best preserved mastodon yet discovered.

Ten years ago there was scarcely a specimen of existing or fossil vertebrates among the collection of Yale College—unless indeed some of her professors were themselves unconsciously shelved. To-day these collections, especially of the rarer forms, have no equal in the world. I see no other way to present the facts than to give full credit to Prof. O. C. Marsh, and state some of his discoveries in as few words as possible. His fossil horses—or rather animals of the horse family—from the $4\frac{1}{2}$ toed quadruped, no bigger than a fox, to fully developed and single-hoofed steeds not to be distinguished from those of the present day—illustrate the successive strata of the rocks from the lowest eocene epoch upward, by no less than forty species, all different, yet all indicative of the gradual development of the modern horse. Another series of animals forming the connecting links between reptiles and birds has been very largely illustrated by Prof. Marsh's labors. All the steps of this most important chain of development have not yet been ascertained, but the contributions to it from the fossils of the West that are in the Peabody Museum make the few other discoveries in this field of research comparatively insignificant. Of birds that existed in the Cretaceous epoch, there are, for instance, only two known (from fragments) in Europe; here there are the remains of not less than twenty distinct species, there being of each an average of about a dozen specimens. These include the wonderful birds with teeth, appropriately named the *Odontornithes*, which are now divided into two orders, according as they have their teeth set in grooves or in distinct sockets. Of some of these the skeletons are almost complete as to individual birds; and Prof. Marsh is at present engaged upon a large and elaborate monograph on this subject, describing and illustrating the new forms by copious engraved drawings; one of the rooms on the second floor is at present occupied by the skilled assistants and draughtsmen engaged upon this important memoir. Another of the alliances between birds and reptiles, of which the birds with teeth supply such remarkable examples, is suggested by the pterodactyls, or flying lizards of the same cretaceous beds in Kansas. Prof. Marsh was the first to find any pterodactyls in America; these are of enormous size, the spread of their wings being from ten to twenty-five feet. The singular feature about these reptiles from American rocks is that they had no teeth, and hence in this respect they resemble the modern birds. The remains of other reptiles have been discovered in the cretaceous beds of the West, and the specimens here brought together include the bones of several thousand individuals. From these abundant remains Prof. Marsh has been able to determine many doubtful points, such for instance as that the mosasaurs had hind limbs or paddles, and that they were covered, at least in part, with hard, bony scales. The mosasaurs were sea-serpents, from ten to sixty feet in length. Besides these, there are here also the remains of gigantic crocodiles, lizards, turtles and snakes, any one group of which would make the reputation of an ordinary museum. Of the enormous reptiles of geology, none yet known surpassed in size one which Prof. Marsh has recently described. Its remains were found in the cretaceous beds of Colorado; it is named *Titanosaurus montanus;* it was herbivorous, and attained a length of fifty to sixty feet. Believers in a vegetarian diet should take note of these facts, as that saurian was the largest land animal known to have existed on this planet. The reptile will also supply a bone to pick, that will puzzle people who have assumed that animal life in this hemisphere has been in general represented by smaller forms than the corresponding ones of other continents. If the question of size should ever be raised as to the mammals of the West, the Peabody Museum can show the remains of more than one hundred distinct individuals of the dinoceras kind —a new order of mammals from the Eocene of the Rocky Mountains, nearly equal to the elephant in point of size, and armed with four to six horns, as well as formidable tusks; or point to the brontotherium of the miocene rocks —a creature as large as the dinoceras, and also armed with horns. The oldest known member of the rhinoceros family, perhaps its progenitor, has been discovered by Prof. Marsh in the upper eocene of Utah. From the lower beds of the same formation in Wyoming Territory came the tillodonts, perhaps the strangest of all Eocene mammals, as they seem to combine characteristics of the carnivora, rodents, and ungulates. There, also, the same discoverer first found the North American monkeys, which are allied on the one side to the lemurs of the Eastern Hemisphere, and on the other to the monkeys of South America.

The list of these discoveries could be greatly extended, but even a mere catalogue of the novelties would be much too long for this letter, since it would include more than 300 animals new to science, about 200 of which Prof. Marsh has already described in technical publications. In general, it may be stated, that a very large number and variety of animal forms are here collected which enable men of science to trace the connection between the strange creatures of early geological eras and the animals that are living to-day. The changes of form which constitute the life history of the earth are displayed by these fossils in the order in which they actually took place. Until these specimens were found and their characters determined, the story of the development of our existing animals could only have been surmised; no Old World fossil remains supplied the deficiencies of the series, and indeed the evidence was far from conclusive that the change from one form of animal life to another took place in Europe. At all events, these fossils of the West demonstrate beyond a reasonable doubt, concerning certain groups, as to when, where, and how the change did actually occur. In that respect this collection of "fossil vertebrates" is absolutely unrivaled. It also contains, however, a considerable number of European fossils that are of the rarer kinds, or have some specialty that makes them valuable, such as the famous Eichstadt pterodactyl that Professor Marsh secured by a cable dispatch, and by paying a sum of money which (as Prof. Agassiz himself said to me) had the effect of raising the price of fossils throughout Europe. In the lithographic stone that holds the pterodactyl's remains, there appears the impression of the stretched membranes that served the animal as wings, like those of the bat. But there is not room here to go into these interesting details. The arrangement of the cases is somewhat similar to that of the osteological display; their fossil contents, when the specimens are all placed, will be somewhat as follows: Primates (chiefly monkeys and lemurs); Mastodon, Mammoth; Dinocerata, Brontotheridæ; Perissodactyls (horse and rhinoceros families, etc.); Artiodactyls (camel, pig, deer families, etc.); Carnivora; Tillodontia; Bats, Rodents, Marsupials, etc.; Turtles; Dinosaurs; Mosasaurs; Plesiosaurs, Ichthyosaurs; Crocodiles, Lizards, etc.; Fossil Fishes; Pterodactyls and Pteranodons; Cretaceous Birds; (*Hesperornis*, *Ichthyornis*, etc.); Tertiary and Post-tertiary Birds. The last-mentioned division may include extinct birds of the present epoch, which are here represented by about a dozen skeletons of the dinornis or moa (being a much more complete series than is owned by any other museum, with the possible exceptions of that in the British Museum and one in New Zealand); several skeletons of the great auk, and various remains of the dodo. The perfect skeleton of the gigantic Irish elk, as the animal is extinct, will probably find place in this room; but certainly none of the cases can contain this fine specimen, since the spread of its antlers is thirteen feet and two inches.—*N. Y. Tribune.*

ASTRONOMY.

DISCOVERY OF SATELLITES OF MARS.

Professor Asaph Hall, of the Washington Observatory, has recently announced the interesting discovery of two satellites attendant upon the planet Mars. At about eleven o'clock on the night of August 16, Professor Hall, by the aid of the great 26-inch refractory telescope, noticed a very small star following Mars by a few seconds. Two hours later he looked again and to his surprise found that the distance between planet and star had not increased, although the former was moving at the rate of fifteen seconds per hour. Hardly crediting his discovery, Mr. Hall delayed further observation until he could bring the matter before his colleague, Professor Newcomb, and that astronomer, being confident that the discovery of a satellite had been made, calculated roughly its time of revolution, which he found to be one day and eight hours. This enabled the prediction of the probable place on the following night—a prediction which was verified. On the morning of August 17 another satellite appeared, and its identity was fully recognized.

The distance of the first satellite from the planet is between 15,000 and 16,000 miles, which is less than that of any other known satellite from its primary, and only about one-sixteenth the distance of the moon from the earth. It is exceedingly small, having a diameter of not over 100 miles. The inner satellite is believed to be still closer to the planet, and to have a period of less than eight hours. The first moon is distant eighty, the second thirty seconds from their primary. Further and more accurate details will, however, soon be forthcoming, as probably the keen eyes of astronomers the world over will now be turned upon Mars. Next to our moon, more full and accurate knowledge is possessed regarding Mars than of any other heavenly body. Venus is nearer to the earth, but when most closely approximated she is invisible, being concealed by the solar light. Mars, however, may be examined under favorable circumstances, and during the present year the conditions are especially advantageous, owing to the planet being in opposition to the sun, near perihelion. The apparent disk is now larger in the proportion of three to one than when the planet is in aphelion, while the illumination is more brilliant in the proportion of three to two. At the same time the planet is nearer perihelion than previously for more than thirty years; so that in the heavens its brightness is but little inferior to Jupiter.

While the surface of Mars has been mapped with remarkable accuracy, and although probably no other planet has been subjected to more keen and continuous scrutiny, yet up to the present time all searches for satellites attendant upon it have been fruitless. Most astronomers have not hesitated to assert that none such existed, though it has been said that if Mars has moons they are too small to be recognized by any telescope extant; but in any event the probable presence of Martial moons was not to be predicated on any phenomenon exhibited by the planet itself, and if their existence was suspected it was because it would be more in accordance with the nebular hypothesis that they should be present than absent. In a work on astronomy published some forty years ago, we find mention of a phenomenon on Mars which might possibly lead to the idea that the planet was subjected to reflected light from some near body, and that was, that a curious and persistent illumination of the planet had been noticed, which, under the circumstances, was unaccountable, save under the hypothesis that the planet was slightly phosphorescent.

The discovery is a triumph both for Professor Hall and for Mr. Alvan Clarke, the maker of the great telescope. It, besides, shows what may be expected of the still more colossal instrument which at no very distant day we hope to see established in the Lick Observatory.—*Scientific American.*

HYGIENE.

HOBBIES IN DENTISTRY.

BY A. H. TREGO, D. D. S.

It is fair to estimate that no comparatively new science has been developed more rapidly than dentistry in the last quarter of a century. It is not surprising, then, where there are so many self-taught and untaught disciples, that there is a field full of "hobbies" and many poor riders.

One of the most dangerous of these hacknies is the "mallet" for impacting gold in cavities of teeth. An endless variety has been introduced, but none that affords general satisfaction. The more skilled and unbiased operators have found the mallet system to be "more or less imperfect and impracticable, and dangerous in the hands of injudicious operators." One objection is that no mallet has been produced that will strike a "back-action blow." Secondly, it is physically impossible for any "tapper" to know exactly when and how hard to strike; just as it is impossible for one person's muscle to vibrate in unison with another's brain and eye. The danger is that a succession of blows, sufficiently hard to weld gold, is certain to produce congestion of the periodontium.

Disciples of the mallet claim that "taps" are less painful and injurious than "hand pressure concussion." Patients who have tried both most emphatically disagree with them, and practice proves that very many teeth are ruined by the use of mallets. To illustrate, one may apply the full strength of the arm in pushing against another's head and not force him over or produce pain; whereas a slight blow from the fist will knock him down and produce severe pain and congestion.

It is a mistaken idea that gold foil cannot be welded and made sufficiently solid without hammering. It is an established fact that an expert hand-pressure filler will get more gold into a cavity, and do it quicker and better—more evenly condensed, than is ever done by mallet. The most accomplished demonstrators of operative dentistry recognize this as a business fact, and do not consider a student competent to graduate unless he can condense gold perfectly by means of the "vibratory concussion" of hand pressure. Many persons never can accomplish this peculiar grip of hand; hence the indiscriminate and extensive adoption of the "sledge-hammer." A good automatic plugger is indispensable as an assistant to hand-filling, but it requires to be skillfully manipulated—and judiciously let alone.

All new inventions deserve fair trial, and genuine improvements adoption; but in matters as important as the preservation of one's teeth, skill and science should be preferred to "main strength and awkwardness." Electroplating or amalgam of gold (dodecahedrons) is not impossible as the acme of the great desideratum.

Hobby No. 2 is the very prevalent practice of disfiguring teeth by separating or cutting away for the purpose of facilitating filling approximal cavities. In a majority of cases it is not only useless but absolute malpractice. The supposition is that the Creator knew better than any dentist the proper shape for human teeth.

The fashion of extending gold fillings beyond the natural contour of the tooth, showing an unnecessary amount of gold, displays a want of taste and judgment on the operator's part, and a deficiency of refinement on the part of the patient equivalent to the snobbery of wearing superfluous jewelry.

"Rubber Dam" is a hobby that has carried numerous riders far beyond reason and common sense. The dam is a valuable acquisition, but it is used entirely too much. Many use it desiring to have it inferred that they are "up to latest improvements;" and where expert operators would do better without it and avoid pain and annoyance to the patient. The clamps and ligatures employed to hold the dam, and the force required to get them into position, frequently produce peridontitis and permanent injury to the teeth and gums.

Some claim that moisture should be excluded from the cavity while excavating; that the dentine absorbs saliva and renders it liable to decay after being filled. This is an absurb idea; the dentine is as thoroughly saturated while the decay is in the cavity as it is possible to make it, and there is no difficulty in making it perfectly dry when ready to fill. On the other hand, the caries and albumen, when drilled or scraped, form a glutinous paste which can only be removed by frequently syringing the cavity with tepid water; in which case the dam is worse than a nuisance. It is a fallacy that the dam is necessary to prevent the patient's breath moistening the gold, thereby preventing cohesion. The gold is more liable to be soiled from other causes; as for instance, the operator's breath, sultry atmosphere, coal gas, carbonic acid gas, smoke from the annealing lamp, and sulphurous fumes from the rubber.

I use the dam only when obliged to, and have no difficulty, in a majority of cases, in keeping the cavity perfectly dry by means of napkins and other simple and unannoying appliances. I filled teeth twenty-five years ago with "soft gold," by means of smooth instruments, that are in perfect condition to-day, and I have no hesitation in asserting that the "rubber dam" and "mallet" are used seven times in ten to the disadvantage of both patient and operator.

TECHNOLOGY.

ARCHITECTURAL SCIENCE TEACHING.

ELEMENTARY CLASS.

QUESTION.—*Describe different materials used by painters. Describe ingredients of color.*—The materials used by painters are paints, oils, driers, stains, varnishes, etc. Colors or paints may be divided into five classes, according to their principal ingredients. Lead paints, most commonly used, have white lead or carbonate of lead as a basis. This material is ground up in oil in a stiff paste. Linseed oil, with litharge or other driers, and sometimes turpentine, are added to it to form the paint ready for use. The required tint is obtained by adding to this the proper coloring pigment. The exact proportion of ingredients is regulated by the nature of the work, climate, etc. Red lead enters into the composition of the priming coat because it is a good "drier" and sets "hard." Linseed oil is used as a medium for applying the paint; it fills up the wood pores, and acts as a preservative. Turpentine makes the paint easier to work, and more liquid, but it plays no part in the preservation of the wood, as the greater part evaporates. Driers are mediums to cause the contained oil to dry and set quickly. Various materials are used, as litharge, sugar of lead, etc. Zinc paints have zinc oxide as a basis. Silicate paints are manufactured from almost pure silica, which is not acted upon by any metal or acid—in fact is almost indestructible. This kind possesses the advantages of great durability, has no galvanic action when applied to iron, as in the case of lead paint, and does not tarnish by the action of gases. Colors are made same as the lead paints, and are mixed in the same way. Oxide of iron paint acts as a good preservative for iron-work. Bituminous paints are used for a similar purpose, and for rough carpentry. Stains are mixtures used to darken wood to the color of the imitated wood. Varnishes are of various kinds—copal, etc.—and are used to preserve the paint, and give a gloss to the finishing coat.

QUESTION.—*Describe the process of common painting wood and ironwork.*—Woodwork is prepared for painting by brushing over all resinous knots with a thin coating of knotting (a compound of shellac dissolved in naptha), or gold size, to confine the resin, and prevent it running under the paint. The priming is then laid on, any plain color, well worked into the pores of the wood, with and across the grain; when this is dry, the stopping is done. All nail and brad holes, etc., must be well filled up with putty, and lightly rubbed over with glass paper. The second and following coats are applied with more care, brushed with the grain, and the work covered equally well everywhere, showing no tool marks or running edges. If the last coat is to be light, the second and third should be similar in color, and if it is to be finished dark, dark color must be used for the previous coat. Ironwork should be cleared free of all rust, oil, or grease before painting. A good first coat is color made up with red lead; the other coats may be similar to that used for wood. Iron being almost non-absorbent, three coats are sufficient for new work, unless in very exposed situations, and for the same reason, care must be taken, especially in ornamental work, not to fill up the fine lines of leaf-work, etc., by using too much paint, as the character of the work would thereby be injured. It is not so much a thick coat as a thorough one that is the best protection.

QUESTION.—*In coloring walls what precautions should be used?*—The walls should be thoroughly dry. In coloring walls the coats should be carefully laid on and smoothly, each coat being rubbed slightly with sand paper before applying the next. The "flatting" or finishing coat should be made a few shades lighter than the pattern, as it darkens in drying. Japanner's gold size, if used, should be applied quickly, as the turpentine evaporates quickly, leaving an indelible glossy surface. A certain time should be allowed between the coats, the drying of the same depending upon the quantity of driers used, the weather, and temperature of the apartment. To expedite the work, new walls are generally "distempered" when not dry enough to receive the permanent decorations. Distempering is a kind of painting with color prepared with size or some other glutinous substance. In distempering, the walls must be dry and free from damp; if not, at the completion will be shown all the defects. Two or three coats should be applied, in order to obtain an even color.

ADVANCED CLASS.

QUESTION.—*Explain the theory of coloring.*—The accepted theory is that there are certain colors that cannot be produced by any combination of other colors. They are termed primaries, because all other colors can be obtained by mixing them in certain proportions. The primary colors are red, blue and yellow. Some authorities substitute green for yellow. Secondary colors are derived from mixtures of the primary colors in pairs—as violet from red and blue, orange from red and yellow, and green from yellow and blue. Tertiary colors are produced from secondaries—as citron from orange and green, etc. White and black are usually considered neutrals. To secure "harmony of colors" they must be equalized to the varying proportions shown in the solar spectrum—the three primaries being used either in their purity or compounded. The eye being constructed to see white light, when looking on a colored surface, it is best pleased by a contrast. Contrasting colors to harmonize should be mutual complementaries of each other—making up the full complement of colors contained in the solar rays. The complement of any primary—say, red—will be the secondary compounded from the other two primaries—as green from blue and yellow—red will thus harmonize with green, blue with orange and yellow with violet. The best proportion for mixing primaries, so as to harmonize, is: red, 5; blue, 8; and yellow, 3. The latter is the most vivid, and should obtain a prominent position. Blue is least vivid and retiring, and should be kept in the background—red to be used as an intermediate color.

QUESTION.—*Describe the proper mode of painting wall surfaces.*—To paint wall surfaces properly often five coats are necessary; but if the plaster be not very absorbent four will be sufficient. If the work is required without gloss the last coat is mixed with turpentine only, which is called flatting; if the work be not flatted the finishing coat is two of turpentine to one of oil. For the priming coat boiled oil should be used, then the three coats of white lead and oil, or more if required; generally the first coats should be some shades darker than the finishing coat. The proper drier to be used for walls is sugar of lead, and in painting wall surfaces great care should be used in selecting the very best quality of oils and white lead—the older the oil the better.

QUESTION.—*What is the best paint for ironwork?*—The best paint for ironwork is either the oxide of iron paint, known as the Torbay paint, or the silicate oxide paint, both consisting of oxide of iron and silicious matter, to which any color may be added and applied in the usual way. They can be applied even after the surface has commenced to rust, as from their nature they amalgamate freely with the rust, forming an impervious coating adhering well to the surface, and yet sufficiently elastic to prevent cracking when the iron expands or contracts under variations of temperature. Bituminous or tar mixtures, thinned with linseed oil, are well adapted for ironwork, especially when they can be applied hot, or to the heated surface of the metal, so as to insure a firm adhesion by entering the pores. A mixture of silicate oxide with tar also forms a good durable coating on iron. When ironwork is to be painted with ordinary lead paint red lead should be used. The adhesion of such a coating on ironwork can seldom be depended on in consequence of the non-porous surface. This is further prevented by the galvanic action that sets in between the iron and lead. Galvanizing, or coating the surface with a preparation of zinc, is also frequently resorted to as a preservative. With all such coatings the surface must be perfectly clean and free from rust. It is advisable, so as to prevent rusting, that all ironwork should be coated with some preservative soon after it leaves the mould, forge or mill.—*Building News.*

PHYSIOLOGY.

CURIOSITIES OF THE VOICE.

Some years ago, a delightfully interesting book was written by Sir Chas. Bell, on "The Human Hand." There might be fully as interesting a work written on the mechanism of the human voice, in which would be equally demonstrated the power, wisdom and goodness of the Creator. We offer a few observations on the subject. Until recently there were mysteries difficult to explain concerning the wonderful inflections in the voice. Now, it is thoroughly understood how words are produced, and how the throat is able to send forth a wide variety of charming notes in singing. We begin by mentioning that Dr. Mandl has devoted himself to the study of the organs of speech, and from his work on "The Larynx" we give some interesting particulars. Investigators have long been occupied with researches; but, until they had seen the larynx of a living being, one thing only was proved—that the voice was formed in the glottis. For fifty years of this century they were trying by mirrors and other appliances to examine the interior of this organ, but without results. Suddenly an inspiration came into the head of a celebrated singer, whose name awakens charming remembrances among old amateurs. This was M. Manuel Garcia. Ignorant of all the trouble which surgeons had taken in order to observe the movements of the throat in the act of singing, he conceived the idea of looking at himself. By the help of two mirrors, the one reflecting the image on the other, he saw the whole of his larynx depicted. In ecstacy before the glass, he determined to pursue the accidental discovery which had been so long dreamed of. But the autumn had set in, and the sun's rays, which were necessary to success, did not lend their aid. London with its fogs forced him to try artificial light, the results of which were unsuccessful, and therefore he could only profit by fine days; yet he soon recognized how isolated sounds were produced. In 1855 the Royal Society received some communication from him on these curious studies.

The subject was at once taken up with great activity, especially in Vienna, where success was far from equaling the hopes of the doctors. The caprices of solar light and the defects of artificial threw them into a state of despair. By all means they must improve their mirrors. Czermak, the Professor of Physiology at Pesth, taking an example from the instrument used in examining the eye, the ophthalmoscope, had recourse to a concave mirror which concentrated the light. From this time there was no difficulty but to perfect the lenses. Czermak, having acquired great skill in the use of his laryngoscope, visited the principal cities of Germany, where his demonstrations deeply interested surgeons and physiologists. He was warmly received in Paris in 1860, where he showed not only the whole length of his larynx, but also the interior of the trachea or windpipe as far as its bifurcation; a spectacle truly astonishing to those who witness it for the first time. It is not possible to examine the organ of the voice with the same facility in all; a man must have had some experience before he can do it.

A slight sketch of this organ will perhaps make the subject clearer. From the breast there rises to the middle of the neck the passage for the air between the lungs and the mouth; at one end it is divided into numerous branches, called the bronchial tubes, at the upper end, like the capital of a column, is seen the larynx, resembling an angular box; strong cartilages make it very resistent; and the interior is lined with a mucous membrane forming folds, named the vocal lips. These separate, lengthen, or shorten, in the formation of various sounds. The largest of the four cartilages rises in an annular form, and protects the whole structure. It is but slightly shown in the neck of the female, but strongly marked in the man, and is popularly called Adam's apple. Like everything else, the larynx presents individual differences; a fine development is an indication of a powerful voice; as the child grows up there is a sudden alteration and increase of size; but it always remains smaller in the woman than in the man; the angles are less sharp, the muscles weaker, the cartilages thinner and more supple, which accounts for the sharp, treble notes in their voices.

Singing demands a different kind of activity in the organs from speaking. In society, where education requires a submission to rule, singing belongs to the domain of art; but, in a primitive state, all nations have their songs. Musical rythm drives away weariness, lessens fatigue, detaches the mind from the painful realities of life, and braces up the courage to meet danger. Soldiers march to their war-songs; the laborer rests, listening to a joyous carol. In the solitary chamber the needle-woman accompanies her work with some love-ditty; and in divine worship the heart is raised above earthly things by the solemn chant.

A strong physical constitution, and a perfect regularity in the functions of the organs used in singing, are inappreciable advantages. They should be capable of rendering an inspiration short and easy, the expiration slow and prolonged; there is a struggle between retaining and releasing the air, and with the well-endowed *artiste* the larynx preserves its position, notwithstanding the great variety of sounds which it emits. But the evolutions of the parts are multiplied, the vocal lips vibrate, and the configuration of the cavity modifies the sounds which are formed in the glottis, and determine the tone of voice. The most energetic efforts of the will cannot change this tone in any sensible manner. Professors injure their pupils by prescribing the position of the mouth, from which perhaps they themselves derive an advantage.

It is interesting to watch the play of the organs by the help of the laryngoscope, and see the changes which succeed one another in the low and high notes. At the moment when the sound issues, the glottis is exactly closed; then the orifice becomes a very long figure, pointed at the two extremities. As the sound rises, the vocal lips approach each other, and seem to divide the orifice into two parts; then as the highest notes are sounded, there is but a slit the width of a line. The vocal lips change like the glottis; they stretch out, harden, thicken, and vibrate more and more as the voice rises. Women, who have a smaller larynx, and shorter vocal lips can sing higher notes than men, with a tone less powerful, but sweeter, more uniform, and melodious.

The ordinary limits of the voice comprehend about two octaves of the musical scale; it can easily be increased to two and a half; but some reach the very exceptional range of three, and three and a half. Thus, at the commencement of this century, Catalani astonished every one who heard her, as a sort of prodigy. Suppleness and intensity may be acquired by practice, as has been proved in the case of many singers: the voice of Marie Garcia was harsh, but it became at last the delicious one of Madame Malibran. In general, the natural gift is manifested without culture; the child endowed with this great charm warbles like a bird for amusement; a lover of art passes by, listens with surprise, and promises glory and fortune to the rival of the lark. Thus the famous Rubini won his triumphs. Occasionally the singer has in a moment lost all power, and an enchanting voice will disappear never to return; such a misfortune befell Cornelia Falcon.

Those who have watched the formation of vowels and consonants, can describe very precisely the positions which the lips, tongue, and palate take in articulation. Yet almost identical sounds can be produced with different positions. As we all know, the teeth are a great help to pronunciation, but a person who has lost all his teeth can modify the play of the lips and tongue and express himself intelligibly. Actors imitate the voice of public characters so as to make the illusion complete. The ventriloquist can make his voice issue as if from a cavern. When misfortune has deprived a man of the whole or part of his tongue, he can still hold a conversation, though the sounds are never particularly agreeable. All this shows that there is nothing absolute in the actions which form words, though in general the same organs play similar parts. Those who were born deaf have ceased to be dumb by interpreting the movements of the mouth with wonderful certainty; they guess the words of the speaker instead of hearing them, and so learn to speak by imitation, their speaking, however, being seldom well modulated. There are now several institutions where the poor creatures who have been deprived of one of their senses can acquire a means of communicating with their companions without the tedious intervention of writing. The master indicates to the child how he must open his mouth, place his tongue and lips; he then draws the pupil's hand over his own larynx, so that he may feel the movement. Those who, like the writer, have seen this reading from the lips, will be struck with the surprising delicacy of the impression made on the eye which has been thus cultivated.

In comparison with the human voice, that of animals seems poor indeed. The barking of the dog, the mewing of the cat, the bleating of the sheep, cannot be called language, in the proper sense. Yet the larynx of these creatures is on the same plan as that of man. Among monkeys the resemblance is perfect. To all appearance the impossibility of speaking is due to the formation of the lips and tongue. In 1715 Leibnitz announced to the French Academy that he had met with a common peasant's dog that could repeat thirty words after its master. In spite of such an authority, we must always say when we most admire the intelligence of this faithful companion, "He only wants words." So well endowed with memory, affection, and intelligence, he can only express his joy by sharp, short expirations of air through the glottis. Howling is a prolonged note in the pharynx, excited by deep grief or pain. Yet they in common with many other animals can communicate with each other in a marvelous manner when they wish to organize an expedition. A dead bullock was lying in a waste, far from all habitations, when a solitary dog, attracted by the smell, came and fed upon it; immediately he returned to the village and called together his acquaintances. In less than one hour the bones were picked clean by the troop.

Opportunities for studying the language of wild animals are rare; they fly from man, and when in captivity they become nearly silent, only uttering a few cries or murmurs. Travelers have sometimes been able to watch the graceful movements of the smaller African apes. Living in the branches of trees, they descend with great prudence. An old male, who is the chief, climbs to the top and looks all around; if satisfied, he utters guttural sounds to tranquillize his band; but, if he perceive danger, there is a special cry, an advertisement which does not deceive, and immediately they all disperse. On one occasion a naturalist watched a solitary monkey as he discovered an orange-tree laden with fruit. Without returning, he uttered short cries; his companions understood the signal, and in a moment they were collected under the tree, only too happy to share its beautiful fruit. Some kinds possess a curious appendage, a sort of aërial pouch, which opens into the interior of the larynx and makes a tremendous sound. These howling apes, also called Stentors, inhabit the deepest forests of the New World; and their cries, according to Humboldt, may be heard at the distance of one or two miles.

If it be ever possible to observe the play of the larynx of animals during the emission of sounds, the subject will be a curious one. The difficulty seems almost insurmountable, as their good-will must be enlisted; yet M. Mandl, full of confidence in his use of the laryngoscope, does not despair. After man, among animated Nature, the birds occupy the highest rank in Nature's concerts; they make the woods, the gardens, and the fields, resound with their merry warbles. Cuvier discovered the exact place from which their note issues. They possess a double larynx, the one creating the sounds, the other resounding them: naturalists call the apparatus a drum.

Thus two lips form the vocal cords, which are stretched or relaxed by a very complicated action of the muscles. This accounts for the immense variety of sounds among birds, replying to the diversity in the structure of the larynx.

The greater number of small birds have cries of joy or fear, appeals for help, cries of war. All these explosions of voice borrow the sounds of vowels and consonants, and show how easy and natural is articulation among them. Those species which are distinguished as song-birds have a very complicated vocal apparatus. For the quality of tone, power, brilliancy, and sweetnes, the nightingale stands unrivaled; yet it does not acquire this talent without long practice, the young ones being generally mediocre. The parrots which live in large numbers under the brightest suns, have a love for chattering which captivity does not lessen. Attentive to every voice and noise, they imitate them with extraordinary facility; and the phenomenon of their articulating words is still unexplained. It is supposed that there is a peculiar activity in the upper larynx. As a rule, they attach no meaning to what they say; but there are exceptions. When very intelligent and well instructed, these birds—such as M. Truefitt's late parrot, an account of which appeared in this *Journal* in 1874—can give a suitable answer to certain questions.

Our notes on this interesting study come to a close. Man is well served by his voice; words are the necessity of every-day life; singing is its pleaure and recreation, whether the performers are human beings or birds—*Chamber's Journal.*

SCIENTIFIC EDUCATION.

COMMENCEMENT ADDRESS, BY ALFRED P. BOLLER, C. E.,

To Graduating Class of '77 at Rensselaer Polytechnic Institute.

Once more, in the sequence of events, the season of the year has arrived when the higher educational institutions throughout the land are all aglow with the excitement of "commencement day," while fathers and mothers await the hour, with proud satisaction, when the coveted parchment, certifying to all manner of learning, will have been formally bestowed upon their representatives in the rising generation. Thenceforth, the diploma becomes a family heirloom, to be carefully stowed away in its japanned tin case among the family archives, or perchance hung upon the wall of the family sitting-room in a handsome frame, a daily reminder of what "our boy" has accomplished. Amid all the changes that have taken place in our educational systems, the practice of a public introduction to the world, of the completed product of such schools as confer degrees, is one that even the most radical iconoclast has not attacked. The commencement season is no meaningless formality, but an important epoch in the life of each generation as it passes along. It is at once the beginning and ending of a never-to-be-forgotten period of one's life. From the controlling influence of home and the instructor, the young man steps at this season into the arena of wordly strife, and thenceforth must bear the responsibilities of his own actions. Further than this, every graduating class adds just so many units to the world's educated intellectual forces, out of the clashing of which are evolved those ideas upon which the progress of humanity depends. Commencement day is therefore not alone a time of public congratulation for the honorable completion of a task, but a solemn occasion to signal the entering upon a new life of a class of young men, to whom is given a very important part to play in their country's development. As such it will always have an interest for society, the members of which will gather on all commencement occasions, year after year, as they have always done, not only paying a cheerful tribute to intellectual success, but also warmed up by that great under-current of human sympathy, that makes life worth the living. Like the wedding day, commencement day will never lose its interest for society, but will stand as long as the school and college from the basis of our social well being. The laudable ambition to excel in educational advantages, has in recent years taken a firm hold of the American people, and countless schools and colleges have been established all over the Union. While some are the outgrowth of a pardonable vanity on the part of a wealthy donor ambitious to perpetuate his name in a community out of which he sprung, the greater portion have been created in response to a demand for knowledge among the masses, impelled as it were by the exactions of increasing culture. Taking them altogether, they are evidence of a nation's effort toward intellectual advancement, and are a standing rebuke to those pessimists who love to dwell mournfully on the "degeneracy of the times." It is a matter of regret that so many of these newer colleges are weaklings, anticipating by years the capacity of the community in which they are situated to properly support. While giving every credit to the motives which founded them, they are costly evidences of the unwisdom, with which men of wealth, ambitious to serve the cause of education, often discharge their self-imposed stewardships. Had the same amount of wealth that has been scattered throughout the country in numberless higher class schools and colleges, that for years must have a struggle for existence, been concentrated in well established educational centres, the benefit to the cause of sound learning, would necessarily have been very great, and it is to be hoped that future donors will add their benefactions to existing schools, rather than increase their number. The educational period through which we are passing, is in marked contrast to that which gave character to the generation now fading out of sight. This contrast is sharply drawn, and it will be in harmony with this evening's celebration, to ask your attention to some of the leading features of the "new education"—what it has done for society, and what course its future development will probably take. In the first place it is to be remarked, that educational systems are not determined by purely human inspiration, but rather the result of certain social conditions, forming the soil, as it were, out of which grows that system which it is best capable of nourishing. The "*Novum Organum*" could no more have been a product of a barbarous society, than the rose a product of the desert. In all social movements it is impossible to determine the exact line of demarcation between two radically different systems, so imperceptibly does one merge into the other. We know when a change is complete, and we are struck by the contrast with that which it has displaced, but the ending of one, and the beginning of the other, cannot be defined. As in all things the new never displaces the old without a struggle, so the ideas of the new education have not won their well nigh universal acceptance without vigorous opposition from the old regime of school men. It is the story over again in a different shape of the "Revival of the Arts and Sciences" in the fifteenth century, when the supporters of the scholastic wisdom of the middle ages had to yield to the progressive culture of a newer school. That contention history has handed down to us as the struggle between the obscurantists and the humanists, apt terms, tersely embodying the distinct qualities of each. The obscurantists of our day, what few of them are left, are represented by those who would base educational systems upon transmitted opinions, on metaphysics and the literature of bygone ages. With such nature is held up to the test of authority, and in case of disagreement, so much the worse for nature. On the other hand our modern humanists repudiate authority as such, regard society and civilization as a development, and test all ideas and asserted truths, in the crucible of natural law and order. While the germs of the new system can be traced back through centuries, in a fitful sort of a way, it was not until the close of the sixteenth century, when Francis Bacon, whom Pope pronounces the "wisest" and "best" of mankind, despite his moral infirmities, gave to the world a system of logic, at once so profound, complete and penetrating that it marks an intellectual epoch, and formed the solid foundation of modern processes of reasoning. He expressed his disgust at the school methods then in vogue in these words: "They learn nothing at the universities but to believe. They are like a becalmed ship, they never move but by the wind of other men's breath, and have no oars of their own to steer withal." They whole key of Bacon's teachings is embodied in the idea that all learning, all knowledge should have but one object —"the good of humanity." He held that study instead of employing itself on wearisome and sterile speculations, should be engaged in mastering the secrets of nature and life, and applying them to human use. Instead of hypotheses, he called for facts, and he showed that the only road to truth was by proceeding from effect to cause, thus utterly reversing the customary methods of mental training and culture. It so happened that the intellectual soil succeeding Bacon's time was ripe for just such seed, which has grown and expanded into a tree bearing fruit of abundant promise. The growth was slow at first, but the dropping of its blossoms from time to time rapidly reinvigorated the soil in which it had taken root, and to-day we see its overshadowing branches extending throughout all civilized nations. The tangible fruit of this "tree of knowledge" is *science*, the true meaning of which term it is important for us to bear in mind. As formerly used, it was applied to those branches termed physical, and there are those who have no higher conception of its meaning. In the present and developing order of things, it has a much broader signification, and refers more to a certain method of investigation than to specific subjects. Its scope embraces all fields of human research that are capable of being brought under general laws, based upon observed facts. Science aims to bring "thought in harmony with things," and whatever subject is traceable from effect to cause, by inductive processes, is a legitimate field for scientific investigation, be it religious, social, political or physical. The growing demand, on the part of the intelligent masses, for popularized science is due to the recent appreciation of this very broadened view of the meaning of science. So long as science was confined to the investigations of certain branches of purely physical interest, and taught as was done at our universities a quarter of a century ago, popular interest in it was rather of a sentimental kind. Science, however, when applied to higher problems, such as life, politics or religion, comes home to the thinking individual with a transcendent power, and creates in him a very craving to know to what hitherto hidden Arcana he is being conducted. As applied to education, the scientific method of investigation, as a system, is comparatively modern, and was the natural consequence of the discovery of the successful application of steam to practical uses, the opening era of the most stupendous advancement in things material, intellectual and moral, that the world has ever seen. None other could exist in a soil so prepared and, as a consequence, we have seen the system based upon old university methods of scholasticism and tradition gradually fade away, until the bare bones are left, and even they are crumbling into the dust of antiquity out of which they sprung. The science system of education, the "new education," as it is sometimes called, is unassailable, in that it is a natural one, utterly untrammeled by reverence for the past, or devotion to a "school." It seeks nature before the study, and inculcates the acceptance of all truth based upon the facts of nature, as the only sure foundation of a progressive culture. It wars not with ideas, but with error, and is only intolerant of a refusal to accept truth regardless of consequences. It is impatient of shams of all kinds, and quickly pierces the shield of the charlatan. Jealousy, or a desire to restrict knowledge to a few, it is incapable of fostering, but on the contrary is aggressively active in disseminating information among the masses, which in turn produces a reflex action in the elevation of character and morals. The new system is but the legitimate evolution arising from social betterment, and none other than a "material age" could have supported its development. I am aware that this term "material" is often offensive to any well meaning people, but is nevertheless true that the whole history of society shows that all intellectual advancement is based upon certain material conditions. Food for the stomach, clothes for the back and a cover for the head, are the individual's first needs. Due attainment of these in a greater or less degree is necessary before the receptivity of the mind is such as to appreciate the idea that a man is two sided, intellectual as well as animal. The intellect, like the body, grows by what it feeds upon, and if this food of which it partakes, consists of an active participation in the affairs of commerce, of mines, or manufacture, it is not to be wondered that its legitimate craving becomes a search after the facts and phenomena of nature, the proper appreciation of which is so essential to still higher social advancement. As civilization progresses, the luxuries of one age, imperceptibly become the necessities of the next, and any given generation would deem it a hardship to be compelled to return to the practices of their forefathers. The railway, steamship and telegraph have made the whole world kin, and year by year draw the nations of the earth together, through a community of interest and an enlargement of sympathy.

Before the age of steam, the experiences and observations of men, were limited to the narrow surroundings of their localities. Now the experiences of the world are brought to their feet, and they realize that so far from being independent factors in the guiding of events, they are so many units in the ocean of humanity, with a definite part to play in the scheme of development, and of an importance just in proportion to their power and wealth, both intellectual and material. Glorify the present as we will, we must not despise the past. There are names in antiquity associated with such commanding genius, and almost divine prescience, that they will live so long as literature is studied or science cherished. Emerson says, the "world has always been equal to itself," and take it at any part of its unquestioned history, it only has produced that which its intellectual soil and material condition was capable of nourishing. In the highest sense, the greatest triumph of science has been the reflex action upon culture and morals, as evinced in the emancipation of the minds of men from baneful superstitions, witchcraft, terrors of the untaught imagination, and a harmful reverence for tradition. Omens and auguries, long potent in influencing the actions of men, no longer hold sway except among the ignorant and unlettered. Such mental fetters could not last under a system that teaches men that truth alone is worthy of study, to observe nature and follow her teachings. It is this contact with pure truth that elevates mankind, clears the head and purifies the heart. That broadens the sympathies until they take shape in efforts for the amelioration of mankind, and inculcates the idea that the welfare of society is that of the individual. This spirit of science, which is truth, through self interest and sympathy, finds scope for expression in the building of hospitals, in the organizing of charities, in the improvement of laws, in the extension of the benefits of life insurance; in the elevation of the laborer, and in efforts towards adjusting his relations to his employer. The spirit of science is a great leveler of caste, teaches the equality of men before the law, and shows nations the conditions under which they can govern themselves without the intervention of kings. It has extended to woman control over her own property, and abolished slavery. The scientific spirit has taught people that disease is not a Providence, but neglect of the laws of health, only to be contended against by a due observance thereof; that epidemics are preventible, and that rain will not fall without the necessary atmospheric conditions for its precipitation. Take all these reflex results of the new system of education, couple them with the direct physical pursuits of science, the improvement in the modes of living, of water supply, of drainage, the railway, the steamship and telegraph; and compare the result in the effect upon the one problem of life, "Human Happiness," with the best that can be said of the old regime of scholastic education. It is the comparison between the electric light and a candle.

What future developments science has in store for us, it would be rash to forecast with any attempt at details. We know that a vast amount remains to be done, so long as an ideal condition of society beckons us on. There is still an incalculable amount of want, and misery, and suffering, in the world; whole communities in ignorance, and many unadjusted questions between labor and capital. What is known as social science is just beginning to take form, and a host of problems growing out of it are to be worked out. The great work of the new educational system in the future will be the training of men to grapple scientifically with these social problems in all their complex relations, political and physical, and to sow broadcast among the people the idea of *causation.* That things proceed not by chance, but by law, that out of nothing, nothing comes, that there can be no effect without a cause, and that the operations of nature are conducted according to a system instituted when matter was formed and force originated. In physical matters, it is hardly probable that the world will ever see again such startling discoveries as those which have fallen to the lot of this century. The spirit of the "new education" will extend its benefits, and in the end carry them to people yet to be civilized. It will send out more workers in physical fields than ever before, but their work will consist in the development of details, and in the careful scrutiny of the by-paths that the past revolutionary discoveries, so to speak, have opened up. Of such work there will be an endless amount, indications of which are seen in the number of investigators in special lines of research, which from past experience we may expect will be sub-divided from time to time into still other special fields of study, as material accumulates. Civilized nations have insensibly adopted a system of divided labor, as a matter of economy partly, but principally because it has been forced upon them by the limitation of human powers. The system is not without its disadvantages, however, in that the specialist, devoted to one class of ideas, is apt to lose sight of the relativity, of all knowledge, and to elevate into a fictitious importance the study he may have in hand. Like the aged German professor who had but one regret on his death-bed, and that was that he had not been spared a few years longer to complete his investigations of the Greek particle *a*, to the study of which he had devoted his life. The most far-reaching consequence of the general acceptance of the scientific method of investigation, and the latter day broadening of its scope, is its effect upon such speculative and practical questions regarding life, as have profoundly interested men from earliest times. It is pretty plain to most thinking men, that the idea of intellectual freedom is spreading among cultured nations, and with it a broad humanitarian view of men's relations to each other. Under the light of science, old landmarks are being swept away with a remorseless hand, and doctrines and ideas that once seemed as unchangeable as the everlasting hills are being questioned with a penetrating earnestness. What were supposed to be historical facts are either discovered to be no facts at all, or must be so modified in their interpretation, as to have an entirely new significance. Opinions are formed more slowly now than of old, just in proportion as the amount of evidence to be weighed is so much greater now than them. History must be re-reviewed in the light of modern discoveries, which have followed each other during the last quarter of a century, so thick and fast as to task the intellectual strength of a generation to arrange and classify in their scientific bearings. There are more gifted men than ever before, more specialists in every realm of human thought, and more searchers after truth, who, in all parts of the world, are accumulating facts and data, on which the generalizations of future philosophers are to be based. So far as new discoveries and methods bear upon material matters, our only interest is one of present use. We take a new idea to-day, only to throw it off to-morrow for one better adapted to our needs, and so advance from day to day to greater prosperity and comfort. But when we come to estimate the effect of new ideas and discoveries upon speculative matters, and apply the modern scientific method of analysis by induction, we shrink from the inconoclasm thereby involved and often deliberately shut our eyes with stubborn persistence, rather than contemplate for an instant the possibility of error in the cherished teachings of our youth, or in the convictions of mature age. This is perfectly human, is therefore natural, and should not involve the calling of hard names. Being natural, this tenacity in matters of opinion, or of convictions having all the force of truth, play an important part in the scheme of intellectual development, must be weighed as a factor thereof, and not treated simply as an obstinate superstitious phase of human nature to be banished by cynical sneers. Whatever may be the outcome of what may be termed an age of intellectual unrest, through which we are traveling, one thing we can take calm contentment in, and that is in the final exaltation of *truth*, which is the highest aim of science. That end may be a long way off, but so surely as all nature is subject to the law of development and change in some form, so surely will some future generation attain the beatitude of perfect intellectual rest. If, indeed, we ourselves do not find it beyond the experiences of this life—the mysteries of which neither the chemist's crucible nor the biologist's microscope can solve.

Gentlemen of the graduating class, as a practicing member of your chosen profession, I may be permitted to extend to you the welcome of fellowship. You have entered the profession of civil engineer at a time of peculiar depression in all matters pertaining to public works, railways and manufactures—and have added to the members of a profession full almost to overflowing. It must be admitted that purely professional practice has not a very encouraging outlook to those whose affiliations are not such as to have positions provided for them. In times of great public disaster, such as have followed the commercial world for the last four years, the engineer is the one to first feel the blow, and the last to recover in returning prosperity. His office is one of disbursement, which appears so directly on the expense side of the ledger, that it usually overshadows the indirect benefits with which it should be credited on the other side of the account. He would be a rash man to prophesy a new era of such prosperity as we thought we had previous to '73. How far this prosperity will prove to have been real, it is difficult to say, until all the loose ends are picked up, and the balance sheet finally struck. Just at present the civilized nations of the world are in possession of enormous productive capacities in all departments of manufactures, apparently far in excess of their respective markets. Transportation facilities seem to have fully kept pace with the manufacturing developments, and their extension at this time does not hold out a very enticing prospect to capital—at least in undertakings of any magnitude. It is hopeless to expect a speedy rectification of the lost equilibrium between supply and demand, or that it will be restored without further financial suffering. New markets must be sought in undeveloped countries, and population must increase to a greater or less extent to utilize what the United States, England, France and Germany are now capable of producing. Until the balance is restored, prices will rule low, competition will be fierce, bankruptcies will be frequent, and capital will accumulate at financial centers in safe depositories, at low rates of interest. I must confess that the picture presented is not an encouraging one for the rising generation, but an early acceptance of the situation is certainly philosophical, if not agreeable. My object in alluding to such matters on this occasion, is to disabuse your minds of any ideas you may have formed of an early resumption of constructive activity in new works, which would give ample scope to your professional ambition; and further, to indicate the direction that I conceive to be the one where such an educational training as is given by the Rensselaer Institute will prove of value. I allude to the region of *economics*, the obtaining the most out of the least. In times of high prices, when prices are abnormally large, the idea of profit by saving is apt to be overlooked. On the other hand, when prices are low, the question of any profit at all, is a matter almost entirely of saving, The manufacturer, the merchant and transporter, are all asking themselves, *not*, how large a price they can charge for the commodities in which they deal, or for services rendered, but what is the lowest possible price for which such commodities or services can be afforded. Such questions involve a multitude of details, and it is just here where scientifically trained men have a large field before them. The economical organization of labor, the perfection of machines, the prevention or utilization of former waste, the rectification of past constructive blunders—are all questions of legitimate scientific study, which invested interests are rapidly recognizing. The economics of transportation, the management of railways and canals, are subjects that will repay the profoundest study, and in these directions the field for a brilliant professional reputation is most enticing. There are numberless vexed questions and unsolved problems in connection with transportation matters, that only scientific methods of thought, coupled with practical experience and observation, can grapple with. Ex-President Grant is credited with the remark, that certain public men had the misfortune to begin their career as major-generals. There is a world of wisdom in the remark, no matter what its source, or to whom it applies. It is, indeed a misfortune to rise in the world more rapidly than one's knowledge and experience warrant. Let me, as a matter of advice, caution you against the ambition of getting ahead too fast. All the schools in Christendom cannot take the place of experience. They can at best only prepare and furnish the mind, so as to make experience *scientifically* usable. It is, therefore, and in fact necessary, for a professional beginner to start low in the ranks, so that he may be familiar with the manner in which things are done, if he ever expects to take a high position in the command of men, and in the management of things. In other words, he must *know* how things are done, before he can *instruct* others to do them. In conclusion, let me remind you, that you go forth under the standard of an Alma Mater that has made a record in almost every state in the Union—see to it, that in your lives and practice, you honor her, as she this evening honors you.—*Van Nostrand's Engineering Magazine.*

FOREIGN CORRESPONDENCE.

PARIS, SEPTEMBER 1st, 1877.

Meteorology is the least known of the sciences, and any progress recently made therein—and it is much—is to destroy many ideas hitherto received as exact. The subject was so near us, observations were so familiar that we concluded to exclude remote causes. Some laws were found to be contradictory, and deductions more apparent than true. It is only now that we begin to observe that solar spots have connection with the weather, and to suspect the stars as producing variations in the atmosphere. We must elsewhere than on the surface of the earth seek the explanation of these disturbances.

The spots on the sun are so gigantic, so enormous, that the earth might pass through one of them without ever producing a shadow. These spots, continuing several weeks and sometimes months, serve as data for calculating the sun's rotation on itself. During forty years M. d'Anhalt-Dessau has noted, day by day, the sun's spots: he found they varied, the maximum and minimum being, in a sense, periodical. Contemporaneously with these observations, General Sabine observed the variations of the magnetic needle. Ordinarily, the latter varies, more or less, towards the east or west. Now these sudden variations, almost nervous-like in their deviations, have been remarked to be greatest when the spots on the sun are most numerous. M. Wolf, of Zurich, after twenty-five years' observations, corroborated this parallelism. Also, photos of the sun have revealed the unexpected and inexplicable fact that when Venus and Mercury are between the sun and the earth the solar spots diminish in size, but resume their primitive dimensions when these planets recede into the distance. The same results have been noted when Venus and Jupiter or Venus and Mercury are in the same degree of latitude in the zodiac, that is to say, in conjunction.

The magnetic needle, as just stated, undergoes variations, more or less abrupt, following the greater or less presence of the solar spots; similarly, inequalities in the variations of the needle have been detected as the planets are in conjunction. Is it not strange, nay, wonderful, to behold the magnetic needle reflecting the movement of stars so distant as Jupiter and so small as Mercury? Is it not singular to observe that needle oscillate more strongly as Jupiter and Venus are in conjunction, or when Mercury approaches the sun? Thus sun and planet act upon a phenomenon—the variations of the needle—till lately believed to be terrestial. But there is more; it has been observed that the cyclones in the Indian ocean were greater in proportion as the spots on the sun reached their maximum; also, that there is an apparent connection between the solar spots and the degree of temperature, and the humidity of the atmosphere. M. Broun affirms there is a relation, beyond doubt, between the revolutions of the sun and moon and the variations of the needle and the fluctuations of the barometer. All these phenomena seem to indicate that they are not the cause, the one of the other, but the effect of a dominating cause, up to the present unknown.

The extraordinary curative properties of salicylic acid and its combinations has led to its application for the purposes of adulteration. The poisonous fuchsine has been used to color wine; now salicylic acid is employed to preserve it, but not in the charitable end to cure articulate rheumatism. This new agent of adulteration is dangerous, for we are not quite certain about the real properties of the acid. As the latter "preserves" wine, there is no reason why it ought not to be employed to "salt" milk and butter, in fact, used everywhere as a preventive of fermentation and putrifaction. Despite the measures taken in France to protect the public health it is the exception to find articles of food pure. Tea is so adulterated with powdered iron, which is gummed to the leaves, that if a magnet be thrust into a package on being withdrawn it will be found to be covered with particles of iron—a metal not so bad as copper, certainly, and superior to gypsum, Prussian blue and black lead.

It is often necessary to suddenly augment the power of marine steam engines, for a short period. To do so, the intensity of the furnace must be increased, and this is effected either by means of an energetic ventilator or introducing a jet of steam from the boiler. M. Bertin, naval engineer, prefers the second plan, as the first often occasions loss of life if the door of the furnace be opened incautiously; but he has invented a machine, now employed on board the Resolute, frigate, by which blasts of compressed air are suddenly forced, by means of a centrifugal ventilator, through the bottom of the furnace. The combustion is doubled under the transitory action of the jet, and the motive power increased in the same proportion. There is an increase, also, of 20 per cent. in the consumption of fuel. M. Cailletet, to whom we are indebted for the invention of burning the gases which escape from ordinary fires, has effected the same for the gases of the chimneys of manufacturies, utilizing the heat generated by their combustion. The gases at the forges of Cheneciere, which escape from the furnaces, pass under a boiler 30 feet long, which they heat, then they pass into a fire-brick chamber containing a metal box, inside of which are thin plates of metal that the gases maintain at the required temperature.

The "writer's cramp" is so called, doubtless, because it is neither a cramp nor peculiar to penmen. It is an impotence, resulting from a complete absence of harmony between the muscular and the cerebral movements. A person suddenly feels he cannot write, though his hands are capable of all other work not requiring excessive precision; often the pen falls from the fingers or involuntarily lifts itself up in the air, when the writer must await its good pleasure to descend before commencing another word. The disease may be considered as incurable, and the afflicted ought to consider himself happy if able to write with the left hand. The "piano cramp" is due to the same cause, performers being suddenly unable to continue touching the keys. Often the disease in this case manifests itself in the front part of the upper portion of the arm. M. Onimus attests that the affection is not uncommon with violinists, and the clerks ot the Morse telegraph not only suffer in the same way in their fingers, but along the whole arm. A tailor, when he commenced to sew, noticed his arm turning inward, and fencing-masters can observe the same phenomenon with their swords, although, in both cases, the arm is capable of perfectly executing every other kind of work. A cobbler suffered so much from these contractions that they affected his neck and face, causing him involuntarily to make the most hideous grimaces. The feet also can be attacked. Duchenne quotes the case of a turner, whose foot contracted the moment he put it on the pedal of the machine, though that member was excellent for every other function. The "dancer's cramp" is only another form of the same effect. An enthusiastic clergyman, in order to lead the singing in his church, learned to play the ophicleide; he exhibited so great a passion for the instrument that when he performed he executed such serpentine contortions as to provoke laughter in his flock. Duchenne was of the opinion that the disease is produced by an excessive excitement, or the exhaustive exertion of certain muscular functions, producing a too considerable nerve discharge, and hence, contractions. Professor Bouilland is of the opinion that the malady has its starting point from the nervous centre of the brain, which commands, as is well known, many movements, as those of the eye, speech, and writing. The "cramp" is then simply a paralysis; it is sometimes accompanied by the loss of speech and the power to read. The Professor quotes the case of a civil engineer, who lost the power of speech and writing, yet could read mentally. As physiological, man is in duplicate, if the left hemishphere of the brain refuses to act with the movements of written language, the right hemisphere will be found generally intact and capable of commanding the left hand to function.

M. Blanchard explains the apparent anomaly why an insect, after undergoing all its metamorphoses, becomes, on reaching the adult or leaving stage, enormously larger than the chrysalis in which it was contained. It is not the air introduced into the breathing tubes, as De Belleyne believes, but the insect breathes the air by its mouth, filling its digestive tube with this gas, which sends the blood towards the circumference of the body, obtaining thus mechanically the unplaiting of its wings and the normal swelling of its body.

The discovery of an ante-diluvian elephant by some Siberian fishermen, who were able to eat some of its flesh, draws attention to the question "how did these mammoths come there?" The general idea is that at one time the northern regions enjoyed a tropical temperature, which some cataclysm changed. M. Boyle is of a different opinion; the elephants thus found from time to time in Siberia, have neither lived nor died in that region. At the epoch of the great cataclysms they were transported by strong currents of water from the Himalaya as far as Siberia, where they were stopped and imbedded in the ice. This transport would not have been of long duration. The elephants were very numerous at that period; all were not carried northward, as many remained *en route*, as their bones and tusks testify. In China the ivory employed is that of the fossilized tusks of extinct mammoths, excellent for sculpturing purposes, and English and American fishermen who go far north, haul up with their nets many of these tusks, which are known in commerce as "fossilized ivory."

M. Daubree has made, since some years, meteoric stones his special study. What has produced upon the fragments those erosions and fissures which are the distinctive features of aërolites? M. Daubree asserts, from repeated experiments upon metallic surfaces with gunpowder and dynamite, he has produced the same cavities as in the aërolites, and which are simply due to the expansion of compressed gases. The honey-comb surface of these meteorites is then not due, as is commonly supposed, to the scaling off by the unequal expansion of these extra terrestrial bodies. M. Daubree has produced the same characteristics on iron and zinc. The pressure which our atmosphere exercises on these bodies, on their arrival within its influence, is very great, as they enter at a rapidity of over 60 miles a second; hence, the fragmentation of the aërolite, its successive explosions, its breaking up into a shower of tiny stones, or assuming the appearance of a "swarm." As these bodies have to support a pressure of 3,000 atmospheres, their incandescence is as natural as the fusion of their surfaces.

M. Menier draws attention to pulverization of manures and of soils, as stimulating the action of each. Pulverizing often moderates most completely the properties of bodies in flavor, odor and color. Sugar, too finely powdered, loses too much of its saccharine qualities, takes an odor of caramel and a taste of starch. The more carbon is finely divided, the more it is efficaceous as a deoderizer and disinfectant; hence, why animal black is in such request as a filter in sugar refineries. The finer the body, also the more rapid the dissolution, because a greater surface can be acted upon by water or acid; hence, why powdered feldspar is a manure, by yielding its potash, ground-fossil bones and phosphates. By pulverizing the soil, the farmer discounts the work of time, and by doing the same for manures, he helps the efforts of the roots.—P. C.

CHEMISTRY.

SPECTROSCOPIC DISCOVERY OF OXYGEN IN THE SUN.

Celestial chemistry has taken another stride forward. In a paper recently read before the American Philosophical Society, and printed in the *American Journal of Science and Arts*, Dr. Henry Draper announces the discovery of oxygen gas in the sun, the fact being arrived at and verified by a long course of spectroscopic observations.

Viewed in any of its numerous aspects, this discovery is of immense interest. Whether as an extension of our knowledge of solar physics, solar chemistry, and the nature of the spectrum itself, or as throwing further light upon the constitution of the universe; whether as bearing upon cosmical theories that have attracted much attention, or as a triumph over the difficulties of complicated experiment, or, finally, as an illustration of hereditary genius in science, where a line of research opened brilliantly by the father nearly half a century ago, has been pursued with equal brilliancy to this crowning result—however regarded, this exploit of the younger Draper must command unqualified admiration.

As has been repeatedly shown in our pages, the early Draper was one of the early and most successful explorers of the chemical relations of the luminous spectrum. He was a pioneer in this line of investigation, and the first to make extensive use of photography in this branch of research; and he was so far in advance of his time, that his discoveries were totally unappreciated. But he furnished the fortunate men who followed him with their tools to reap the splendid harvest of spectroscopic discovery, which has so impressed the world during the last eighteen years. We have never had any doubt that history would set all these things right, but the venerable doctor will at any rate be easy in the assurance that the sceptre has not departed from his family.

When it was established that the light emitted by vaporized and incandescent bodies gives spectra by which they may be identified, the passage was rapid to the discovery of chemical substances by the analysis of light. A study of the spectra of the sun and stars soon gave evidence that they contained forms of matter with which we are familiar upon earth. All the metals, for example, in a state of luminous vapor, yielded bright lines in the spectrum so distinctive in each case that there was no possibility of mistaking them. When these were carefully mapped and compared with the spectra from the sun and stars, such a startling mass of coincidences was at once disclosed, that there was no escape from the conclusion of a common causality, or that these metals exist also in the stellar bodies. There was but one serious difficulty. The lines obtained by the combustion of the the metals were bright and colored, while the corresponding lines in the solar and stellar spectra were all dark. Kirchhoff resolved the difficulty in 1859, by showing how the bright lines may become dark lines by absorption in such conditions as the celestial bodies furnish; and it was thus not only established as a fact that there are various terrestrial metals in the sun and stars, but their mode of manifestation was brought into complete harmony with theoretical requirements.

The nebular hypothesis, which had been growing for a century, and which assumed the origin of all the bodies in the solar system from a common nebulous source, was, of course, at once and profoundly affected by the new revelations. It was proved that there are common elements extensively distributed among celestial bodies, which confirms the hypothesis that they have a common origin. Not only was there new and positive proof of the existence of nebulous matter in the celestial spaces, but the ultimate elements of which material Nature is constituted were shown to be universal, and the nebular hypothesis was thus strongly confirmed. Yet a difficulty at once arose, that the main predominant elements terrestrial Nature were not found to exist in the sun and stars. The evidence, of course, was negative, but it was held by many to be weighty, in disproof of the nebular doctrine.

If the non-metallic elements, it was said, which form the principal part of terrestrial objects, do not exist in the sun, the derivation of that body and of its encircling planets from the same primeval source is impossible. Dr. Draper has now proved that oxygen in large proportions exists in the sun (and probably nitrogen also); and his discovery can therefore only be regarded as lending further and more powerful confirmation to the nebular hypothesis.

Dr. Draper's paper, in the *American Journal of Science and Arts*, is accompanied by an illustrative diagram, which brings the demonstration before the eye of every reader. It exhibits the spectrum of the sun, and that which is produced from air, so juxtaposed that the fact and the extent of the identity of the lines in the two representations are seen at a glance. The matching and identification are even more complete than they were in the original experiments of Kirchhoff with the metals, for here it is not necessary to invoke a theory for the unification of bright and dark lines; the bright lines of the spectrum of oxygen being continuous with the bright lines of the solar spectrum. It is, indeed, because the solar oxygen reveals itself by bright lines that these have not been earlier detected, as they have been masked and concealed among the unoccupied luminous spaces, between the dark lines that have hitherto been the main objects of attention.

Dr. Draper has been occupied for several years with this investigation—in fact, he has grown into it. Besides his inherited aptitude, and life-long training in this delicate line of manipulation, and his thorough familiarity with the peculiar difficulties of these investigations, his work could only have become successful by means of a combination of appliances, some of which are only lately available. His task was to produce a gas spectrum, and maintain it at a brilliancy which would admit of its being photographed alongside of that of the sun itself. Oxygen is made incandescent by electricity. The most ample, steady, and sustained command of this agent was therefore indispensable. This was secured by the Gramme machine, a dynamo-electric engine connectedwith a large induction-coil and a battery of Leyden-jars. The impulse was furnished by a Brayton petroleum-motor, which "can be started with a match, comes to its regular speed in less than a minute, and preserves its rate entirely unchanged for hours together." This was belted to the Gramme machine, which, at its usual rate of running, gave 1,000 ten-inch sparks per minute. This "torrent of intense electric fire," consisting of twenty ten-inch sparks per second, was passed through Plücker's tubes, containing oxygen, the spectrum of which is thrown upon a sensitive photographic surface, while the solar spectrum is formed beside it, and both are fixed together upon the tablet. The embarrassments of the investigation are thus referred to in Dr. Draper's paper:

"This research has proved to be more tedious and difficult than would be supposed, because so many conditions must conspire to produce a good photograph. There must be a uniform, prime-moving engine of two-horse power, a dynamo-electric machine thoroughly adjusted, a large Ruhmkoff coil with its Foucault break in the best order, a battery of Leyden-jars carefully proportioned to the Plücker's tube in use, a heliostat, which of course involves clear sunshine, an optical train of slits, prisms, lenses, and camera well focused, and, in addition to all this, a photographic laboratory in such complete condition that wet, sensitive plates can be prepared which will bear an exposure of fifteen minutes and a prolonged development. It has been difficult to keep the Plücker's tubes in order; often before the first exposure of a tube was over, the tube was ruined by the strong Leyden sparks. Moreover, to procure tubes of known contents is troublesome. For example, my hydrogen-tubes gave a spectrum photograph of fifteen lines, of which only three belonged to hydrogen. In order to be sure that none of these were new hydrogen-lines, it was necessary to try tubes of various makers, to prepare pure hydrogen and employ that, to examine the spectrum of water, and finally to resort to comparison with the sun."

In regard to the significance of the inquiry in relation to spectroscopic study, Dr. Draper remarks:

"We must, therefore, change our theory of the solar spectrum, and no longer regard it merely as a continuous spectrum with certain rays absorbed by a layer of ignited metallic vapors, but as having also bright lines and bands superposed on the background of continuous spectrum. Such a conception not only opens the way to the discovery of others of the non-metals, sulphur, phosphorus, selenium, chlorine, bromine, iodine, fluorine; carbon, etc., but also may account for some of the so-called dark lines, by regarding them as intervals between bright lines."--*Popular Science Monthly.*

LEATHER NOT A CHEMICAL COMPOUND.

Chemistry, though it is not exceptional in that respect, is a science in which we are continually unlearning as well as learning. It was formerly believed, and the text-books still assert, that leather is a true chemical combination formed by the hide and the astringent matter. The researches of Knapp have thrown new light upon this question, proving that leather can not possibly be a chemical compound. He has succeeded in making leather without any tanning matter by merely driving the water out of the pores of the hide by means of chloride of calcium and anhydrous ether, and he has then reconverted this leather into its original state of hide by leaving it to steep in water. The experiments of Knapp show that in tanning, the special agent are not absorbed by the hide in an invariable quantity, but that the proportions depend on the degree of concentration and on the nature of the solvent. To penetrate into the hide, to enfold the fibres, to cover them with a precipitate by surface attraction—this is the only part played by the tanning principles. Owing to their presence, the fibres during the drying of the hide do not form a horny mass, but remain supple and flexible. Leather is a really mechanical mixture, and tanning is only a special case of dyeing—*Boston Journal of Chemistry.*

FLORICULTURE.

ROSES IN-DOORS AND OUT.

Among the various plants that can be made to bloom in the window during the winter, but few give more satisfaction, when it does well, than the rose. The New York *Tribune* tells how to manage them so as to make them succeed:

Roses may be grown in-doors with very little trouble, and those who fail have lack of knowledge—a minus quantity generally known as "bad luck." Take the precaution to first remove all the foliage, and cut well back every portion of the unripe wood. The root must never be allowed to dry in the least.

Prepare a little loamy soil from under the sod of an old pasture, or along roadsides, and incorporate with it a portion of clean bar sand. A small quantity of old rotted manure will also be beneficial, though we rely more on liquid fertilizers applied while the plant is in a growing state, as that is the time only when such stimulant is needed.

In potting the plant fill in an inch or two of drainage (some writers maintain that this is useless, but we believe it to be essential to perfect health), and then a portion of the prepared soil. Place the roots in a natural position, do not cramp them, and then fill in gradually the remaining soil, giving the pot an occasional shake to settle the earth well in among the fibres and at the same time press the surface firmly. As a general rule, plants thrive much better when the earth is hard than when left loose and light. The strawberry, for example, cannot be forced to advantage unless the soil has been pounded firm before the runners take root. After potting thoroughly soak the soil, and place the plant in a cool, shady situation until hard frosts set in, when it may be removed to a warm room.

One of the chief points to be observed in forcing all plants is to perform every stage of the process quietly, always beginning in time so as never to hurry vegetation, which is invariably done at the expense of vitality. Plants must have due time to form fresh rootlets in the soil before the leaves and young growth commence their work. Some people put a plant right out of the garden on the approach of cold weather, and then immediately remove it to a warm, sunny window, often forgetting to water it for a long time, and of course it presently becomes "sicklied o'er," and droops. As to varieties of roses for potting, one can not go far astray with the Teas and Chinas; but avoid particularly the Mosses and Hybrid Perpetuals, as these will bloom but once during the winter, and then only sparingly, and with the greatest reluctance. Such good old standbys as the White, and Pink Daily, Hermosa, Agrippina, Safrano, and Cels, as well as the newer Bon Silene and Isabella Sprunt, are always reliable. Do not try to do too much at first—the great blunder of beginners. One or two plants will be enough to start with; another winter one can "launch out." But it is well always to remember that a few specimens, even one in fact, in perfect health, and full of bloom, is far more valuable than many in an unthrifty condition.

A few words in relation to roses which are to remain in the open ground over winter. It is an excellent plan to head back the more tender varieties severely—say within nine or ten inches of the ground—and then cover with coarse manure and litter from the stables. But don't kill with kindness; don't give a coat of manure that would cover the garden, and expect the plant to survive. This is almost certain death. The object is not to keep the plant warm, but to preserve it cool and free from the fluctuating temperature of our trying winter. Sudden freezing and thawing is what does the mischief.

The hardier kinds need only a little protection from the sun, such as is afforded by a few bows of evergreens or rough weeds; but it is a mistake to tie them tight. A particular friend once put his up nicely in corn fodder, thus affording an excellent lodgment for mice—a courtesy which these rodents, with sharp ingratitude, reciprocated by eating up bushes, protection and all. In every case head well back, trimming out the old wood, and the nearer the ground the better; then give each plant a good fork-full of manure, which answers a double purpose.

TO PROPAGATE ROSE SLIPS.

1. There are several methods of propagating rose-cuttings, but one of the simplest is to strike them in a saucer of sand. The wood to be used must be of the present season's growth; the small shoots are preferable. These should be cut into lengths of about four inches (the exact size is immaterial), having three or four eyes or dormant buds. There should be an eye at the bottom of the cutting, as it is at that point the roots are emitted, and not between the eyes. Procure some clean brown sand, such as is used by builders, put it in a saucer, wet it thoroughly, so that it shall be in the condition of mud, then place the cuttings in side by side, having previously cut off their leaves. Place the saucer in the sun and mind that it must have water several times daily, when the sun is hot. The cutting will form what is called a "callous" at the bottom, from which the roots are emitted. Three or four weeks are generally necessary to get the cuttings well rooted, after which they may be carefully pulled from the soft sand (and be sure that it is soft, as the roots are very brittle), putting them in small pots of light, rich soil, and keeping them in a sunny place. Never let them suffer for want of moisture. If the pots can be sunk in the ground, so much the better. When the pot is filled with roots the young plant should be shifted to a pot a size larger. All varieties of roses do not root with equal readiness—the tea or everblooming roses being the easiest, and the mosses the

most difficult. Rose cuttings may be struck at any time of the year and in a warm place, if the wood is young. They may be struck in a tumbler of sand, washing the sand carefully out in a basin when the roots appear. The "saucer system" of striking rose cuttings is applicable to cuttings of many plants which I have failed with by the ordinary methods. I would advise those who attempt it not to be impatient, and, above all, not to forget that the hot sun soon causes the water in the saucer to evaporate.—*The Fruit Recorder.*

HOME DECORATION.

We are pleased with the idea of the *Forest and Stream* that people should provide grasses for bouquets, and, as it says, "Just at present in meadows and hedgerows the different varieties of wild grasses can be obtained in perfection, and they should be much more extensively employed in floral decorations than they are, for not even the most delicate greenhouse fern will give the same airy look to a vase of flowers that a few spikes of wild grasses will impart. It is only a few years since they were first brought into requisition, and ever since—especially in England—their use has been steadily increasing. It is a good plan to lay in a store of the different varieties of grasses at the present time for use during the winter months, when they cannot be obtained in the fields. In cutting them for this purpose each variety should be tied in separate bunches, and care should be taken that they are not bruised together; for if this is the case when the bunch is opened each spike will be found to have dried in its crushed position, and its form will thus be quite spoiled and its value for decorative purposes destroyed. All grasses should be dried in an upright position, particularly those of a drooping character. Oats and rye while still green are also very pretty in large arrangements, ears of black oats which are seldom seen used and which form a striking contrast to grasses and sedges.

To Preserve the Natural Colors of Dried Plants.—The following method of doing this is given in a German pharmaceutical journal, and will interest botanists and others: Dissolve one part of salicylic acid in 600 parts of alcohol, heat the solution to boiling in an evaporating-dish, and draw the whole plant slowly through it, prolonged exposure discolors violet flowers; shake off any excess of liquid, dry between blotting paper, and press in the usual manner. A frequent renewal of dry blotting pads, particularly at first, is desirable. Thus treated, plants are said to dry rapidly, furnishing beautiful specimens, which retain their natural colors in greater perfection than by any other process.—*The Fruit Recorder.*

THERAPEUTICS.

PATENT MEDICINES AND SECRET REMEDIES.

The German chemists are very unmerciful to those who would impose upon the public by worthless preparations; and one Berlin journal the *Industrie Blätter*, edited by Dr. E. Jacobsen, offers to analyze *gratis* any patent medicine sent to them in the original package. The analyses of over *eleven hundred* such preparations, made by Dr. Hager, Wittstein, Rose, Chandler, Reveil, and others, have been collected together by E. Hahn and published in book-form by J. Springer. A few of these analyses we propose to lay before our readers for their information and amusement, remarking, however, that in some cases it is impossible for the analyst to exactly determine some of the organic remedies, such as gums, balsam, and resins, when in combination or solution, and noting the difficulty of accurate translation of pharmaceutical terms:

Dr. Pierce's Golden Medical Discovery. A one dollar bottle holds 220 grains of a brownish colored clear liquid, consisting of 15 grains pure honey, 1 grain extract of poisonous or acrid lettuce (bot. *herba lactucæ virosæ*), 2 grains laudanum, 100 grains dilute alcohol (64 per cent), tasting like fusel oil and wood spirit, with 105 grains of water.

Dr. Livingston's Ant Balsam, a German remedy, consisting of 72 grains castor oil, 2 grains balsam Peru, and 5 drops oil of bergamot.

American Tooth-ache Drops, made by Majewsky in Warsaw, have different compositions. Those which took the prize at Vienna consisted of common salt and brandy, colored with harmless cochineal red (price, 37½ cts.).

Asthma Pastils (Danl. White & Co., New York), according to the analysis of Dr. Fleck, contain 20·1 per cent saltpetre, 3·5 per cent impure scammonium resin, 35·0 per cent gum and sugar, 40 per cent charcoal powder, leaves and stems of some plant.

Ayer's Pills consist of peper, colocynth, gamboge (*gutti*), and aloes.

Ayer's Hair Vigor, a solution of 0·6 per cent of sugar of lead.

Horsford's Baking Powder. One powder contains acid phosphate of lime and magnesia mixed with a certain quantity of flour; the other is bicarbonate ot soda.

Berlin Balsam, for cure of all kinds of sores, burns, cuts, wounds, ulcers, chilblains, etc., is nothing but common glycerine contaminated with a considerable amount of chloride of calcium.

Cook's Balsam of Life is a filtered decoction of 20 parts borax in 250 parts water, and 1½ parts pulverized camphor in 1 liter of liquid. Used externally for toothache and all skin diseases.

Bucher's Fire Extinguishing Powder contains 59 parts saltpeter, 36 of sulphur, 4 os charcoal, 1 of oxide of iron. We fail to see the advantage of this peculiar sort of impure gunpowder as a fire extinguisher.

Non-poisonous (?) Fly Paper, from Bergmann & Co., in Rochlitz, contains a large amount of arsenic!

Iodine Cigars, from J. D. Tormin, in Stettin, bear the motto "No more phthisic;" but contain no trace of iodine. Can the Yankees beat this?

Hamburger Tea contains 32 parts of senna leaves, 16 of manna, 8 of coriander, and 1 of tartaric acid, ground up together.

Dr. Sage's Catarrh Remedy, says Schädler, contains 0·5 grammes of carbolic acid, 0·5 grammes camphor, and 10 grammes common salt, which are to be dissolved in 4-7 liter of water, and injected into the nostrils. It appears very probable that the wide reputation of this remedy is a deserved one, and the publication of its constituents will rather increase than retard its sale.

Croup Powder, from F. W. Gruse, in Berlin, contains 25 parts of common salt, 10 of flowers of sulphur, 25 of fœnum græcum, 25 of juniper berries, 5 of gentian root, and 5 of fennel seed.

Horn's Liton, infallible cure for tooth-ache, contains 5 parts of phosphate of lithia dissolved in 400 parts of alcohol.

Schenck's Mandrake Pills. Hager says that these pills contain no mandrake. They do contain the constituents of cayenne pepper, a bitter extract, and some vegetable powder containing tannin.

Bishop's Granular Effervescent Citrate of Magnesia. According to Löhlein, it contains neither citric acid nor magnesia, but is merely a mixture of bicarbonate of soda and tartaric acid.

Poho, a Chinese essence for headache, etc., consists, according to Hager, of good and pure peppermint oil, rather hard and resinous. According to others, it is a mixture of Epsom salts and peppermint oil, or of the latter with oil of almonds.

R. R. R. consists of a reddish-yellow liquid, that smells of ammonia and camphor. It contains 14 parts soap, 40 parts of 10 per cent ammonia, 640 parts alcoholic extract of cayenne or Spanish pepper, 4 parts camphor, and 2 parts rosmarin oil.—*Scientific American.*

FRECKLES, AND HOW TO TREAT THEM.—Many remedial preparations of a complicated character have been recommended, of which *New Remedies* gives the following:

℞	Zinci sulphocarbol..	2 parts
	Glycerine..	25 "
	Aq. rosæ...	25 "
	Spiritus vini rect...	5 "

Dissolve and mix. The freckled skin is to be anointed with this twice daily, the ointment being allowed to stay on from one-half to one hour, and then washed off with cold water. Anæmic persons should also take a mild ferruginous tonic. In the sunlight a dark veil should be worn.

A French journal recommends a collodion containing ten per cent. of its weight of sulphocarbolate of zinc, as giving excellent result. The solutions of corrosive sublimate and other mercurial salts, often used for the purpose, are more or less dangerous, and should be avoided. The following lotion, which contains only a minute proportion of mercury, is harmless and well recommended:

℞ Hydarg. perchlor...gr. v.
Acid. hydrochlor...gtt. xxx.
Sacch. alb...℥ i.
Spt. vin. rect..℥ ij.
Aquæ rosæ..℥ vii.

The following formula is also highly recommended:

℞ Sulphocarbolate of zinc.. 1 part.
Collodion...45 parts.
Oil of lemon... 1 part.
Absolute alcohol.. 5 parts.

The sulphocarbolate of zinc should be reduced to an extremely fine powder, and should then be thoroughly incorporated with the fluid mixture.

Here is an other, in which white mustard-seed and lemon juice are the chief ingredients.

℞ Pulv. sinapis alb..℥ iij.
Olei amygdal...ʒ ss.
Succi limonum, enough to make a thick paste.

Mix. To be applied as an ointment.

It is also said that powdered nitre, moistened with water, and applied night and morning, will soon remove all traces of freckles. An old fashioned household prescription is sour milk or butter milk, which may sometimes answer the purpose.—*Boston Journal of Chemistry.*

Ammoniated Tincture of Guaiacum for Inflamed Throats.—Dr. Garner, in the *Canada Lancet*, recommends the use of ammoniated tincture of guaiacum in inflammation of the throat whether acute or chronic. The remedy, he says, seems to be totally unknown to some practitioners, and wholly ignored by others. He prescribes it with almost invariable success in cases of chronic hoarseness, employing it in the form of a gargle. In the first stage of quinsy its action is astonishing. In cases of inflamed tonsils or sore throat, when produced by or accompanying measles, scarlatina, cynanche, parotiditis, and croup, he uses the pure tincture by means of a sponge-probang. His formula for a gargle is as follows:

℞ Tinct. guaiaci ammon..ʒ iij.
Liquor. potassæ..ʒ iij.
Tinct. opii...ʒ ij.
Aq. cinnamomi..ad f. ℥ viij.

RICORD'S COUGH PILLS.

Morphiæ hydrochloratis	gr.	v.
Extracti hyoscyami	"	viii.
Rad. belladonnæ. pulv.,		
Rad. glycyrrhizæ pulv.,		
Mellis	āā "	xlv.
Balsami tolutani,		
Ol. theobromæ	āā "	lxxv.

Make into 100 pills. Each contains 1-20 grain of hydrochlorate (muriate) of morphia.

Dose: One pill every 5 or 6 hours in chronic bronchitis, accompanied with cough.

SCIENTIFIC MISCELLANY.

ETRUSCAN REMAINS IN PERUGIA.

The Etruscan remains of Perugia are few, owing partly to the great fire, which, in the year 41, destroyed almost the entire city. Enough of the ancient wall, however, still exist to show the manner in which the Etruscans built, the immense blocks of stone being put together without cement. A few miles outside of the city, in 1840, some laborers plowing in a field were astonished to see the oxen sink down in the earth. Investigation proved that they had broken through the roof of an Etruscan tomb, which was speedily uncovered, and found to consist of ten chambers, and to be full of stone coffins, ornaments, lambs, drinking vessel, and all the paraphernalia of pagan obsequies, in perfect preservation. Most of the coffins have been removed and opened, and many curious objects found in them, which are exhibited at the University Museum, and a visit to the tombs themselves is one of the most interesting excursions about the city. Among the principal treasures of that museum are the Etruscan inscriptions which have been discovered in great numbers in the neighborhood of the city. One of them is the largest on record, consisting of forty-five lines. But its meaning, and even its subject, still remains undetermined, even after the investigations of the best authorities on Etruscan subjects. One is offered quantities of "Etruscan relics" such as bronze idols and stone spear heads, all over the city, but it is well to doubt their genuineness. Of the Roman rule in Perugia there are abundant memorials. In fact one feels that a thousand years is but a little space in history, as one recalls the past of this ancient city—(yet not so ancient as some of its neighbors)—which was growing old before Rome was born! One almost wonders, after straying through the city, to come out into old portions of the corso, the principal street of the modern city, and find the evidences of contemporary civilization. A sewing machine in Perugia seems an anomaly, and gas-lamps a satire.—*Springfield Republican.*

SIBERIAN NATURAL HISTORY.

Dr. O. Finsch, lately returned from a scientific expedition in Siberia, has opened at Bremen an exhibition of the ethnographic and natural history collections made by him during his travels. The specimens have been duly classified by Dr. Finsch himself, and, according to *Die Natur*, whose account of these valuable collections we follow, give a good general idea of the kind of life led by the inhabitants of Western Siberia; in this respect they surpass even the Imperial Museums of St. Petersburg and Moscow. The inhabitants of the whole region of the Obi, lying north of the confluence of the Irtish with that stream, live exclusively by fishing, hunting, and reindeer-breeding. The reindeer is the principal source of their wealth, but the herds have been ravaged during the last forty or fifty years by spenitis, and thus the people have been reduced to great straits. For instance, we are informed that Ivan Taisin, Prince of Oddorsk, who twenty years ago owned 7,000 reindeer, now has only 700. Dr. Finsch's ethnographical collection consists of the following groups: 1. Women's and children's clothing, articles of feminine adornment, needles, and thread, etc; 2. Household furniture and culinary utensils; 3. Men's clothing; 4. Instruments used in hunting and trapping; 5. Sundry other implements, together with requisites for smoking; 6. Fishing outfit; 7. Articles used in public sports and in gaming; 8 Reindeer-harness; and 9. Objects used in religious worship. Besides there is a complete state dress of a Tungu notable, as also sundry specimens of Turkistan and Siberian manufactures. The natural history collection includes a portable herbarium, a great herbarium of plants from the Altai region, mosses, arctic berries, butterflies, beetles, bees, flies, locusts, spiders, shells, reptiles, fishes, and birds, and the last in great variety. Then there is a collection of human skulls, and a number of paleontological specimens. Finally, the economic products of Siberia are represented by specimens of skins, farm-produce, manufactures, ores, and metals.—*Popular Science Monthly, Supplement.*

ARE WE APPROACHING A SECOND ICE PERIOD?

Translated for the Globe-Democrat from a Swedish paper.

Speaking of the summers continually growing colder, the paper referred to makes the following observations, well worthy of attention. It says:

Fossils and very peculiar remnants of palm trees have been discovered in Greenland Bay near Koma, whence we deduce that those regions were formerly covered by a rich vegetation. The ice period of the geologists appeared, and in consequence of the sinking temperature that luxuriant vegetation was wrapped in a shroud of snow and ice.

The temperature sinking, a phenomenon which extended from the North southwardly, and may be established by evidence derived from geology, to wit, by the discovery of fossil plants, seems also to be on the increase in our days. Within the last few years the ice seems to have pressed on from the North Pole far southwardly, as for instance, colossal bodies of ice have been accumulated between Greenland and the Arctic Ocean. On the European coast mariners have come upon ice in latitudes where, in the milder season they usually do not find any, and the cold weather on the Scandinavian Peninsula this summer is derived from the bodies of ice floating about in regions where the gulf stream bends in the direstion of our coasts.

It is a repetition of the observation made in the cold summer of 1865. That unusual vicinity of those bodies of ice made the climate of Iceland so cold that the grain will no more ripen, so that, in view of threatening famine and cold, the Icelanders will have to establish a new home in Norht America. It was the same in the fouoteenth century in Greenland, when the Norwegian colonies were destroyed by the bodies of ice pressing onward.

BERLIN PNEUMATIC DESPATCH.

The proposed pneumatic despatch line in Berlin will have 26 kilometres of tube, and 15 initial stations. The wrought-iron tubes have a clear breadth of 65 millimetres, and lie about one metre below the surface of the ground. The letters and cards which are to be forwarded have a prescribed size, and are inclosed in iron boxes or cartridges, each of which can hold 20 letters or cards. In order that they may pack closely, they are covered with leather. From 10 to 15 cartridges are packed and forwarded at a time; behind the last cartridge is placed a box with a leather ruffle, in order to secure the best possible closure of the tube. At four of the stations are the machines and apparatus needed for the business. The forwarding of the boxes is effected either through compressed or rarefied air, or through a combination of the two. Steam-engines of about 12 horse-power are used for the condensation or exhaustion of the air. Each main station has two engines, which drive a compressing and an exhausting apparatus, the steam for each engine being furnished by two boilers. Large reservoirs are employed both for the condensed and the refined air. The former has a tension of about three atmospheres; the latter, of about 35 millimetres of mercury. The air, which is heated to 45° C. by the compression, is cooled again in the double-walled cylinders which are surrounded by water. The velocity of the boxes averages 1000 metres per minute, and a train is despatched every 15 minutes. Each of the two circuits is traversed in 20 minutes, including stoppages. The entire cost of the enterprise will be about 1,250,000 marks (300,000 dollars).

ENGLISH RAILWAYS.

Much has been written in praise of the thorough construction of English railways and the excellent condition in which they are kept. No doubt, as a rule, they are better built than American roads, and they are generally well cared for; but we have lately seen abstracts of a report made to the Bristol Board of Trade on the condition of an important section of the Great Western Railway, which shows that one of the leading lines in England, and the one on which the fastest trains in the world (53 to 54 miles an hour) are run, is, or *was*, in a disgraceful and dangerous state. A serious accident which had occurred on the line was attributed to the imperfections of the permanent way. A competent agent was sent by the Board of Trade to make an independent inquiry, and he inspected minutely, not only that part of the way situated at the place of the accident, but the whole line from Bristol to Exeter, 77 miles in length, carefully examining every rail and every sleeper, and their adjuncts. While this inspection was proceeding, the company set energetically to work on repairs, employing at one time upward of 500 men in addition to their ordinary staff, and using up £50,000 ($250,000) worth of materials. The conclusion reached by the inspector was, that when he commenced his examination there existed on the Bristol and Exeter section of the Great Western 11,260 defective rails and 8,117 defective timbers, not to mention bolts, plates, and other accessories, imperfectly connected and otherwise incapable of safely resisting the excessive strain of a heavy train rushing along at a speed of nearly a mile a minute, and probably sometimes exceeding even that. Is it likely that so bad a state of thing could be found on any American railway of equal importance—say, on any of the great trunk lines from Boston or New York. *Journal of Chemistry.*

ASBESTOS

It is only quite recently that this substance has risen from being simply a mineral curiosity to a quasi-important article of commerce. On account of its peculiar qualities, being indestructible in fire or by acids, fibrous and capable of being woven into cloth or made into paper, often as fine as the finest flax or silk, or like spun glass, although strictly a mineral product. In early antiquity it was made the subject of curious myths and strange tales bordering on the fabulous. Practically its sole use then seems to have been for winding sheets, in which to burn distinguished dead, or to be spun in napkins which were used at exceptional feasts, and, to the astonishment of the guests, afterwards thrown into the flames, to come out intact, white and purified. At least Pliny mentions this; and it also would appear that Charles I had tablecloths made of it, which he also was accustomed to throw into the fire for the same purpose. More recently stockings and handkerchief were made in Elba of asbestos, as gifts to Napoleon I, while living there an exile. From time immemorial the peasantry, where it is found, in various countries, have turned it to economical use as an incombustible lampwick, for which purpose its power of capillary attraction admirably qualifies it.

Common asbestos, more or less fibrous, but of a powdery, brittle quality, is abundant in most countries, and begins to find its way into some of the industrial arts, but largely mixed with other materials. The strong, long, fibrous sorts, varying in color from pure white to dark brown, thus far are only found in sufficient quantity for commerce in the Italian Alps, at elevations of several thousand feet, and often, for much of the year, buried in the snow. They occur in serpentine rocks in irregular veins, usually very narrow, requiring much heavy labor and blasting to open. Sometimes, but very rarely, masses are found in one lump weighing several hundredweight. More frequently the veins prove very superficial, and give out almost at once. Then, again; they can be steadily worked for years, as they extend or penetrate into the mountains. Although some of these have been yielding as much fibre as there was a demand for since they were first opened in 1871-72, recently the increased call has led to the discovery of new productive veins of the very best quality, which will increase the outcome from a few scores of tons per annum to several hundreds. But the price, heretofore varying from £50 to £100 a ton, according to the quality and condition of the fibre, threatens to grow firmer, owing to the new uses now springing up for it, mostly based on patents, whilst Italian capitalists themselves begin to see the importance of a mineral, of which Italy has as yet a virtual monopoly, and are preparing to manufacture it on the spot where it is found in those goods which already find a steady and increasing demand.

These are chiefly, steam-packing in the rope or loose form for piston and pump rods, and stuffing boxes, and mill-boards for steam-joints, gaskets, man-hole plates, and a species of felting to cover boilers and steam-pipes. The ability of asbestos to resist an elevated temperature, moisture, friction and flame itself, joined to its lubricating quality, specially recommends it for the above purpose. The chief objection with the manufacturer is that, when properly prepared and applied, it lasts too long. As covering for boilers and pipes, it saves 25 per cent. or more of the waste heat; and in domestic uses in cellars, to prevent loss of heat by radiation, it is found to reduce the temperature of the cellar 15°, while raising that of the house abave 10°; *i. e.*, it saves the furnace or steam heat, and sends it where it is most wanted.

Asbestos lining or sheathing paper, especially for wooden houses, for ceilings, floors and partitions, to prevent the spreading of flames and make each room fire-proof, is now attracting attention in America, and must recommend itself to builders generally, as rendering buildings not only safer from fires, but cooler in summer and warmer in winter, and free from insects that harbor in common papers. These papers are made in rolls of any thickness or length, and can be colored or printed with any desirable pattern. Fire-proof boxes for shelves in shops can also be made of this substance, and scenery for threaters, if fabricated of it, would be impervious to flames.

The varieties of abestos are quite astonishing to those who have not made a study of this mineral. No two localities seem to yield precisely similar fibre. In the cabinet of Mr. C. A. Wilson, Genoa, Italy, there are at least one hundred distinct varieties from the Alps alone; one specimen when taken out of the mine was 5 feet long, and weighed 700 pounds, of the most delicate cream color, and soft, like raw silk, after separating the fibres.

In America the asbestos business is mainly in the hands of a Boston company, protected by fifteen patents on various goods, and begins to assume a prosperous condition, calling for increased supply of the crude article, whilst in Great Britain it is chiefly centered in a flourishing Glasgow company, which was the first to risk the novel enterprise of trying to utilize a well-known mineral that has waited more than 2,000 years to become useful to men. In Paris it is begun to be adopted for civil and for public registers in the form of a fire-proof writing paper. Recently, patents have been taken out in America and England to cover its use as a fuel-bed for petroleum in any sort of stove or engine-furnace. It absorbs and retains the oil, its capillary attraction causing it to burn only on its surface, where it is under perfect control and gives out an intense heat. By a simple arrangement the hydrocarbons can further be converted into gas fuel, so it is claimed.

These fact would indicate that there is a business future for this mineral, and that new uses for it are likely to be discovered. The most beautiful varieties of the long, soft flexible and extremely fine fibers, commonly known as "floss," and which are more abundant than the strong, tenacious fibres, yet await a call in the industrial art.—*Iron.*

Fire-Proof Paper.—Asbestos is found in large quantities in the valley of Aosta, in the Italian Alps. A priest of Arezzo, named Victoria del Corana, has experimented with it in the paper-mills of Tivoli, and is now making a fire-proof fabric at a cost of four francs per kilogramme. The The most useful application which has yet been made of the paper is for the decoration of theatres.

Slates.—To test the absorptive capacity of a slate, it is a good plan to place it on edge in the water, leaving half of it above the surface. If the water reaches the top within eight hours, it is porous to a degree. A good slate should not absorb more than one hundredth part of its weight after soaking for twelve hours in water. Slates of a crystalline formation are considered the best. The soundness of a slate can be tested by breaking it: if the fracture presents a splintered and ragged edge, it is sound slate; but if it breaks in a straight line, it is soft. It is said that the quality of slate for roofing improves as it is taken from a lower stratum.

GLYCERINE AS A LUBRICANT.—Chemically pure glycerine, free from water, is recommended as a lubricant for small machines and machinery parts where common oils and fats turn acid or hard, and so clog or smear. Glycerine is of particular suitability for sewing machines, as any accident with it is of less consequence than with oils which soon become dirty.

EDITORIAL NOTES.

ACADEMY OF SCIENCE.—The Kansas City Academy of Science, after the usual intermission during the heated term, resumed its monthly meetings, and held its September session, at its rooms, on the evening of the 25th inst., Hon. R. T. Van Horn in the chair, and J. M. Greenwood, secretary *pro tempore.*

A very interesting paper upon the "History of Alchemy" was read by Prof. T. J. Eaton, which will be published in the October number of the REVIEW, in full.

It was decided that the exploration of the mounds in Clay county, commenced last spring, should be resumed next month, under the direction of Judge E. P. West. The finances of the Academy are not in such condition as to bear a very heavy expenditure, and it is hoped that some of our wealthy citizens will feel impelled to contribute freely enough to this object to enable the Judge to perform his work thoroughly.

At the next meeting Prof. J. M. Greenwood will read an essay on Mathematics, and Prof. Crosby will exhibit the splendid collection of curiosities collected by him during his recent European tour.

MR. J. A. HAMBLETT has been for the past two weeks exhibiting the workings of the Telephone to our citizens, and has very successfully transmited oral messages between the Exposition grounds, the Coates House and the Western Union Telegraph office. Large numbers of ladies and gentlemen availed themselves of Mr. Hamblett's invitation to test the apparatus, and have expressed themselves greatly pleased with it. The Water-works company contemplate putting one in operation between their office and the pumping works up in West Kansas City.

It has been adopted in several of the Eastern cities between offices and factories, and also in some places between the offices of physicians and drug stores, and doubtless will become a much valued labor-saving machine.

AT THE RECENT EXPOSITION held in this city several collections of minerals and ores were exhibited, illustrative of the mineralogy of Missouri, Kansas and Colorado. That by the Missouri River, Fort Scott and Gulf R. R. Co. showed in a very attractive and instructive manner the lead, zinc and iron ores and the coals, marbles, building stones and mineral paints of Southeastern Kansas and Southwestern Missouri, while those displayed by Mr. Curry, of Silverton, Colorado, illustrated in the most attractive and convincing manner the immense wealth of the San Juan region in gold, silver, lead and copper.

The fossils exhibited by Mr. Hare and Mr. Devens were nearly all illustrative of the geology of the region immediately in the vicinity of this city, and prove to those interested in such matters that this field is one well worthy of careful study and research.

THE AMERICAN ASSOCIATION for the advancement of Science met at Nashville, August 29th, and continued in session four days.

Among the members who were elected Fellows of the association were our late fellow citizen Octave Chanute, Esq., and Prof. Paul Schweitzer, of Columbia, Mo.

The following officers were elected for the ensuing year, viz: President, Prof. O. C. Marsh, of Yale College; Prof. R. H. Thurston, Vice President of the Physical Section; Prof. A. R. Grote, Vice President of the Section of Natural History; Prof. H. C. Bolton, Vice President; General Secretary Prof. F. E. Nipher, of St. Louis University, Secretary of Section A; Geo. Little, of Atlanta, Ga., Secretary of Section B; Wm. S. Vaux, Treasurer; Prof. F. W. Clarke, Chairman of Chemical Section C; Henry Wheatland and Samuel H. Scudder, Auditing Committee.

Professor Marsh's paper on the "Introduction and Succession of Vertebrate Life in America," as well as other most interesting papers by Prof. Daniel Wilson, Chairman of the Subsection of Anthropology, Prof. Isawa, of Japan, Prof. Mallory, Prof. J. W. Osborne, and Prof. F. C. Mendenhall, were read and most of them published in the New York *Tribune*. The next meeting of the association will be held in St. Louis, in August, 1878.

MR. EDWIN SHINN, route agent on the Western Division of the Kansas Pacific Railway, while out hunting antelope on Bijou creek, about sixty-five miles northeast of Denver City, Colorado, had the good fortune to find a portion of the leg bone of a mastodon. Being an enthusiast on such subjects, Mr. Shinn was much elated by his discovery and brought the relic to this city at once, where it has been for some time on exhibition at the the rooms of the Academy of Science.

When found it measured over twenty inches in length, but about eight inches, being much decayed, crumbled away. The remaining portion weighs 13 pounds, measures 12 inches in length and 29½ inches around the upper end. It is in an excellent state of preservation and shows the roughened surfaces for the attachments of the muscles as distinctly as if prepared by an anatomist but a few months ago. Doubtless the whole skeleton lies imbedded in the sands of the Bijou creek and may be found by a diligent and well directed search.

IN explanation of the unusual delay in issuing the present number of the REVIEW, we can only offer the excuse that the occurrence of the Kansas City Exposition in September absorbed about two weeks of the time of the editor, printers and binders, to the exclusion of almost everything else, an excuse which all who attended the Exposition and saw how completely our citizens devoted themselves to it, will accept as valid and sufficient.

THE exploring party sent out by the Kansas State University during the past summer, according to *Harper's Weekly*, discovered a number of a very rare species of beetle of the genus *Amblychila*, the acquisition of which has long been an object by collectors of coleoptera. For the purpose of securing funds to defray the expenses of their explorations, the authorities of the university offer specimens for sale at a moderate price.

STANLEY "AFRICANUS" has followed up his explorations with such perseverance, energy and courage as to have perfected the work of Livingstone and Cameron in Central Africa by proving that the rivers Lualaba and Congo are one and the same stream; which places him at the head of living explorers.

DR. SCHLIEMANN has offered to present his collection of Trojan curiosities to the South

Kensington Museum, London. These curiosities belong to the prehistoric period, and consist of reliefs taken from the five cities on the hill or plateau of Hassarlik. This collection is altogether unequalled, for, with the exception of two goblets found in the tomb of the kings of Mycenæ, nothing of the kind has ever been discovered.

THIS month has been characterized by an unusual amount of meteorological disturbances in various parts of the world, among which we note earthquakes and volcanic eruptions along the Pacific coast of South America, a few smaller shakes in different portions of the United States, storms and cyclones on the Gulf of Mexico and across the central portion of United States from St. Louis to Pittsburgh.

Cotopaxi, the highest active volcano in the world, has recently experienced a violent eruption, accompanied by most destructive floods of water, which, pouring out from the craters, drowned not less than one thousand persons. The event occurred on the 26th of July. Enormous quantities of ashes and cinders fell upon the surrounding country. Over two thousand heads of cattle were destroyed, and the loss of smaller animals was much greater. There was a great eruption of Cotopaxi in 1768; also in 1855, and one in 1856.

PROF. MUDGE, of Kansas, writes to us from Manhattan on the 15th, announcing that he has, during the past summer, which he has spent in Colorado, "had very fine success in obtaining some new gigantic Dinosaurs."

BOOK NOTICES.

POPULAR SCIENCE MONTHLY. We have just received the October number of the Popular Science Monthly, published by D. Appleton & Co., New York. Price, $5 per annum.

Its contents for October are as follows: Bathybius and the Moners, by Prof. Ernst Haeckel. Molecular Magnitude, by L. R. Curtiss. Simple Experiments in Optics, by Eliza A. Youmans, illustrated. On Elementary Instruction in Physiology, by T. H. Huxley, F. R. S. Cosmic and Organic Evolution, by Lester F. Ward, A. M. Pessimism and its Antidote, by Charles Nisbet. The Modern Piano-Forte, by S. Austin Pearce, Mus. Doc. Oxon. Snoring, and How to Stop It, by John A. Wyeth, M. D., illustrated. Mars and its Satellites, by Prof. Daniel Kirkwood. Huxley's American Lectures, by Prof. E. Ray Lankester. Specimens of Educational Literature, by F. W. Clarke, illustrated. The Psycho-Physiological Sciences, by Joseph Rodes Buchanan, M. D. The Decline of Party Government, by Prof. Goldwin Smith. Sketch of Prof. Jevons, with portrait. Correspondence, Editor's Table, Literary Notices, Popular Miscellany, Notes, making a most interesting and valuable number.

THE POPULAR SCIENCE MONTHLY, SUPPLEMENT, No. 5; D. Appleton & Co , New York, 96 pp., octavo, 25c.

After an existence of only five months this valuable "annex" to the Popular Science Monthly has become a permanent success, almost, if not quite, as indispensable as the original magazine. It is made up of selections from the writings of the foremost scholars and workers of the world, culled from the very best periodicals published on either side of the ocean, and fully carries out the objects of the publishers, who announced that it would "represent the course of contemporary thought on on subjects of leading interest, preserve its most permanent elements and form a comprehensive and independent scientific library."

THE GARDENER'S MONTHLY AND HORTICULTURIST, edited by Thomas Meehan, vol. xix, No. 225, September, 1877; Chas. H. Marot, Philadelphia, Pa.; monthly, 72 pp., octavo. $2.10 per annum, post paid.

This old friend makes its appearance with the greatest punctuality every month, with a table of contents as fresh as spring and almost as comprehensive as an encyclopædia. One of its most marked features, aside from the able articles of its learned editor, is its host of letters from all portions of the world, written for the most part by experts in horticulture and floriculture. It will pay any one who loves flowers and trees to subscribe for and read it.

THE LOCUST PLAGUE IN THE UNITED STATES, by Chas. V. Riley, M. A., Ph. D., with 45 illustrations; Chicago, Rand, McNally & Co., 1877, pp. 236, duod. $1.

This work is a condensation of all the articles, essays and reports made by its indefatigable author during the past three years, including some made during the investigations of the committee appointed by Congress, of which the author was and is a member, with practical recommendations for the destruction of the pest. It deserves a wide circulation, especially among agriculturists.

THE SCIENTIFIC AMERICAN, Munn & Co., N. Y.; weekly, large quarto, illustrated, $3.20 per annum.

It is useless to undertake a description of this most valuable periodical, which, with its Supplement, is a household word among mechanics, artisans and scientific men of all classes. To those who are not acquainted with it we can only say, send ten cents to the publishers and get a copy as soon as you can.

VAN NOSTRAND'S ENGINEERING MAGAZINE, October, 1877, No. 106, Vol. 17, D. Van Nostrand, N. Y., pp. 96, large octavo, $5 per annum.

This is probably the most purely and strictly scientific magazine published in this country, and judging from the greatly increased number of original articles in the present number, it is rapidly becoming the exponent of the mathematicians, engineers and metallurgists of the country; there being no less than seven original articles in this number, besides about ten pages of reports, editorials, etc.

THE NORTH AMERICAN REVIEW, September and October, 1877, No. 258, third edition, pp 204; J. R. Osgood & Co., Boston. $5 per annum.

The captivating article in this number is that on The "Electoral Conspiracy" Bubble exploded, by Judge E. W. Stoughton, written in reply to that of Judge Jere Black in the previous number, though there are many others by eminent writers, such as Dion Boucicault, General McClellan, Emerson, David A. Wells, E. L. Burlingame, "A. Striker," Felix Adler, and Thos. A. Scott. Being one of the oldest American periodicals, is is almost unnecessary to say that it is one of the most substantial and reliable.

WE are much gratified to receive from H. O. Houghton & Co., Boston, the AMERICAN NATURALIST in exchange. It is an 84 paged illustrated monthly magazine, devoted especially to Natural History, Geography and Microscopy, but at the same time containing first-class articles upon all the topics of scientific inquiry. It is edited by Prof. A. S. Packard, Jr., whose connection with it alone insures the utmost care and accuracy in every department, while the list of contributors numbers such eminent naturalists as Profs. Asa Gray, J. D. Whitney, O. C. Marsh, A. Agassiz, F. V. Hayden and more than twenty others of the leading scientific investigators and writers of this country and England. Price, $5 per annum; single numbers 35c.

THE KANSAS EDITORS' ANNUAL for the year 1877, Kansas Publishing House, Topeka, Kansas, 1877, 54 pp. octavo.

This is a very neat pamphlet containing the proceedings of the annual meeting of the State Editorial Association, its by-laws and constitution, the Annual address by Capt. King, of Topeka; also a sketch of the excursion to Colorado, by the same elegant and fascinating writer, the sermon on "Human Reason and Christian Faith," by Rev. John A. Anderson, of Manhattan, and a list of the newspapers published in the state.

WE have also received copies of the latest numbers of the following scientific and literary periodicals: The Popular Science Monthly; The American Naturalist; The Sanitarian; The Phrenological Journal; The Monthly Weather Record; Mines, Metals and Arts; The London Telegraphic Journal; The London Journal of Applied Sciences; The Kansas Farmer; The Western Agriculturist; The Illustrated Journal of Agriculture; The Fruit Recorder; The Industrialist; The Library Table; The Publishers' Monthly; The Brookfield Gazette; Osage City Free Press; The Miami Republican; Leavenworth Daily Times; St. Louis Weekly Times; also The Biennial Catalogue of the Kansas State Agricultural College 1875-1877; Foster on Animal Vaccination; Circular No. 8 from the Surgeon General's office, a Report on the Hygiene of the United States Army, 568 pp., quarto; Seventh Annual Report of Water-Works Commissioners, Columbus, Ohio.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

VOL. 1. OCTOBER, 1877. NO. 8.

PROCEEDINGS OF SOCIETIES.

THE KANSAS ACADEMY OF SCIENCE, 1877.

The Tenth Annual Meeting of the Kansas Academy of Science convened at Topeka on the 11th of October, 1877, and closed its session on the evening of the 12th. The business meeting convened at the office of Dr. Thompson, at which the following members were present: Prof. F. H. Snow, Mr. Savage, Mr. Foster and Miss Mozley, of Lawrence, Professors Mudge and Kedzie, of Manhattan, Dr. Brown, of Leavenworth, and Messrs. Adams, Cooper and Thompson, of Topeka.

The meeting was called to order by the President, Prof. Snow. The minutes were read and the treasurer's report made.

Dr. Halley, of Kansas City, on behalf of its Academy of Science, invited the Kansas Academy of Science to hold its next semi-annual meeting in Kansas City, which invitation on motion was accepted.

Committees were appointed for nominating officers and other purposes, and the academy adjourned till evening.

In the evening an address was delivered in Representative Hall by Prof. B. F. Mudge on the subject: "The Value of Science." The object of the lecture was to show that all science has a practical value; that there is no dividing line between that which is practical and that which is purely abstract. Every truth and fact in nature has its use and its value.

No one would have dreamed that the discovery of the constituent elements of the planets would result from a man blowing soap bubbles and watching the effect of the rays of light passing through them. Yet so it was; but more than that: So utilitarian has science become that at the present day we can make steel rails for our railroads at a less cost than iron could have been produced twenty years ago, because the spectroscope indicates precisely the heat necessary to carbonize the mass. No one would think that flying a kite, would lead to transmitting messages three or four thousand miles by electric telegraph. Studying the habits of birds, insects and plants will inure to the benefit of the farmer, merchant and mechanic. At the close of the address the professor was warmly congratulated on the ability and practical character of the lecture.

On Friday morning Prof. Snow called the society to order.

The first paper read was on the subject: "The Boston Natural History Society," by Prof. M. V. B. Knox. The writer, not being present, the president read the paper. It gave the history of a society which has become famous for the work it has done towards popularizing the study of natural history. In its early days it had all the drawbacks that usually attend such institutions. All the attendance at some of their early meetings could be comfortably seated on a sofa; but by slow steps, and after many interruptions, donations of money and buildings, as well as books and specimens of natural history, began to flow in, putting it on a sound footing, and now it is doing as thorough and efficient work as any society of the kind in the world.

Mr. John H. Long, of Olathe, had a paper on a "New Method of determining the Velocity of the Wind." The author not being present, the paper was also read by Prof. Snow. It explained the ingenious methods employed by Mr. Long for the subject named. The apparatus consists of a post firmly set in the ground, from the top of which four arms extend; a hollow ball of given size and weight is suspended from one of them, and the amount of deflection of the ball from the perpendicular is watched for fifteen minutes, several times daily, the distance of deflection being determined by the graduation or the arc over which it swings. The velocity of the wind is then determined by calculation. The force required to move a given weight over a given space being known, the velocity of the wind can be easily determined. The results showed it to be a much more accurate instrument than the best anemometer now in use.

Prof. Wm. K. Kedzie read a paper on "Ozone in the atmosphere." He mentioned the fact that he at a former meeting read a paper on this subject, giving results of observations as to ozone in the atmosphere of Kansas. His observations, with the aid of others, have still been continued. The object has been to determine facts bearing upon questions of the healthfulness of the Kansas climate. If no demonstration has yet been arrived at, the observations made go in the right direction. Ozone was discovered by Schönbein, of Basle, in 1840. It is produced in our atmosphere by electricity, by processes of oxidation, by the evaporation of water, by the process of vegetable growth. It is more abundant in winter than in summer. It is more abundant in Kansas than in many of the states further east.

Among the persons who have assisted Prof. Kedzie during the past year in his observations on this subject, he mentioned the following: B. B. Smythe, of Ellinwood; Prof. J. B. Dunbar, Topeka; Dr. A. H. Thompson, Topeka; W. H. Carruth, and J. H. Long, Lawrence, and L. B. Hurdt, Canada. He described the tests employed in detecting ozone in the atmosphere and determining the quality, and mentioned many circumstances under which the existence or absence of the substance may have a relation to conditions of health.

The paper elicited some discussion and comment, bringing out the idea that observations should be made in other directions. Such, for instance, as the state of the barometer, thermometer, anemometer and not least, the forms and types of disease prevailing in the community at the present time.

F. G. Adams, of Topeka, read a paper on the subject: "How to Popularize Practical Science." He suggested that the academy should take action to procure a wider dissemination of the results of the labors of its members. He said he did not mean to depreciate what the Academy has already done to spread a knowledge of scientific facts among the people. That looking over the papers which have been read before the Academy and published as its transactions from year to year, during the nine years since its organization, it is abundantly evident that much has been contributed of value to the public, and calculated to popularize scientific study and investigation. There has gone out for popular instruction, much information as to the resources of the state in the various departments of natural history, as to its mineral wealth, its climatic characteristics, etc. Yet the conviction must rest in the minds of all that a still wider diffusion of benefits from the work of this body would be desirable.

It is through the newspaper press and the school room that he would suggest that this greater work be promoted. He said to the members, if hitherto the journalist has drawn, trom the results of your labors, the means to extend the scope of his work, and if the teacher has found in what you have brought in here means for the better instruction of his pupils, is it not clearly desirable that these channels of public instruction should be enlarged; that by direct and systematic action the members of this body should not only be investigators of scientific truth, but through three channels promulgators of elementary science among the people.

The newspaper and the school room are the great avenues of thought and instruction. The journalist eagerly grasps for his columns whatever is presented, prepared for the comprehension and interest of the common mind and within the limits of space which he can spare. The newspaper moulds and reflects public sentiment. The teacher brings into his class room whatever public sentiment compels him to impart as instruction. It remains then only for scientific men to make science readable to the common mind in brief form. Then the newspaper is reached; then public sentiment is enlightened and moulded, and its reflection compels science teaching in the schools.

He did not mean to suggest that any paper ever read before this body was not prepared in readable English. He hoped no discourtesy to this body or any member of it would appear in any word or suggestion he should make. But he meant to say that an essay or scientific paper read before the Academy might be forever locked up within the lids of a state report—never to reach the people for their instruction. Or such papers, prepared for scientific ears only, may not be prepared for the comprehension of the unscientific newspaper readers, or it may be too lengthy for admission into the newspaper columns.

He referred to essays which had been read by Prof. Riley, Prof. Snow and others, containing unanswerable arguments in support of science teaching in the common schools, but which had been little read by the public. Such essays should be cut up into newspaper proportions and got before the people.

He spoke of the evidences manifested in many ways of the growing demand on the part of the people for scientific information, and attributed it largely to the work of the Academy, notwithstanding little direct effort had been made to popularize such information. How much more, then, might be done with well-devised effort.

He moved that a committee be appointed to take action on the subject.

Profs. Snow, Mudge. Kedzie and others favored the motion, and it was adopted. The committee was appointed as follows: Judge F. G. Adams, Prof. B. F. Mudge and Prof. F. H. Snow.

Prof. F. H. Snow, of the State University, read a paper on the insect *Amblychila cylindriformis.* He said the subject was perhaps of greater interest to entomologists than to the general public. It related to the discovery of an insect in Western Kansas which has previously been exceedingly rare and in great demand among collectors at from $12 to $20 per specimen. Several hundreds of these insects have been taken during the past season by the Kansas University expedition, in charge of Prof. Snow, and by the Yale College expedition, under S. W. Williston. The insect is a beetle (order *coleoptera*) and is very interesting in its habits. It is not to be found by daylight, but must be hunted after sundown and before sunrise. It is carnivorous in its nature, living exclusively upon other insects. In confinement it makes itself useful by devouring maple-worms, grasshoppers, and other pests of the orchard and garden. The discovery of this species in such numbers has created considerable excitement among the entomologists of both America and Europe, who are now seeking to supply their cabinets with this hitherto rarest and costliest of insects.

Prof. J. D. Parker, of Kansas City, filed a paper on the subject of the River Bluffs, which had been already published in the transactions of the Academy.

Prof. Snow presented a paper prepared by Lewis Walson, of Ellis, containing a list of the birds of Ellis county.

Prof. Kedzie read a paper on the "Iola Mineral Well," in which was made the following comparison of the composition of the water of the Iola well with those of the "Congress" and "United States" springs of Saratoga.

IN GRAINS TO THE IMPERIAL GALLON.

	Iola.	Congress.	United States.
Bi-Carbonate of sodium,	8.158	7.472	3.240
" calcium,	60.687	99.592	64.672
" magnesium,	25.485	72.152	43.192
" iron,	3.929	.248	.520
" lithium,		2.992	3.040
" barium,		.760	.752
Chloride of sodium,	971.506	400.440	141.872
" potassium,	17,909	8.048	8.604
" magnesium,	7.305		
Sulphate of potassium,		.888	
Phosphate of sodium,		.016	.016
Iodide of sodium,	Traces.	.436	.048
Bromide of sodium,	Traces.	8.552	.848
Alumina,		Traces.	.096
Silica,	.602	.840	3.184
Organic matter,	2.000	Traces.	Traces.
Carbonic Acid Gas, (Cubic inches.)	145.981	432	240

Prof. Snow gave "Additions to the Birds of Kansas," mentioning only two additions during the past year. The number now reaches 297.

Dr. A. H. Thompson; of Topeka, read a synopsis of a paper upon "Science Among the People." He took the ground that there had been more advance made in the popularization of science amongst the people of this country and that the average standard of the knowledge ahd appreciation of science was higher in America, as compared to the total population, than in any European country. This is largely due to the commendable enterprise exhibited by the newspapers of this country in bringing science before the people, to the innovation of science teaching in the schools, etc. But the cause of popular education in science is yet in its infancy. Much has been done, but much remains undone. Every man in every calling is the better fitted for his calling by having a scientific knowledge of the principles underlying the details and materials with which he works. The individual, the class or the nation which fosters and cultivates science, has greater mental strength, purer character, more peaceful life and more solid prosperity than the one which does not. We must then go forward with the work of popularizing and spreading science among the people.

AFTERNOON SESSION.

E. A. Popenoe, of Topeka, read a paper entitled "Notes on Kansas Birds." The paper comprises a list of the birds of Shawnee County observed during a period of six years residence. The number catalogued is 189, and notes are given on dates of spring arrivals, nesting and other habits. Several rare birds are noted, among them, the Morning Warbler, the Palm Warbler, the Swallow-tailed Hawk, and Western Prairie Falcon, etc., and a notice and description of an albino female King-bird, taken at Silver Lake in the spring of 1874. This is a true *rara avis*, as albinos are nowhere common, and among the Fly-catcher family, to which the King-bird belongs, are very rare. The paper notes also the discovery of the nest and eggs of Nuttall's Whippoorwill, a bird which is frequent in occurrence near Topeka.

Facts are given relating to the eastern or western distributions in Kansas of many species, from notes taken during an expedition of two months' duration, to Rooks and Graham Counties.

F. G. Adams exhibited a black-board sketch showing a section of surface geology adjacent to Topeka, together with specimens of materials illustrating the section and explained what appeared to be the relations of the materials to the soils of the neighborhood.

A brief discussion followed, in which Prof. Snow mentioned what he had observed of interest and profit to an agricultural community growing out of such observations in connection with the Essex Institute in Massachusetts.

Prof. Mudge presented a statement of the remarkable discoveries made during the past season, in Colorado, of new genera and species of Dinosaurs. The first were brought to light by Prof. A. Lakes, of Colorado, and others since by Prof. M. Three species are larger than any land animal heretofore known. The size of a few of the bones will give a close idea of the whole animal. The thigh bone (femur) is five feet eight inches in length, weighing 380 pounds. The shoulder blade (scapula) was six feet two inches long. Vertebra fifteen inches in diameter.

No entire skeleton was found, but one entire hind leg, including the toes, measured thirteen feet. As the reptile had long hind legs, and the ability to stand erect upon them, his head, when in this position, was thirty-five feet from the ground. When living he must have weighed twenty to twenty-five tons.

Intermingled with the same deposits were the bones of very small dinosaurs, also new to science, which indicated an animal when living of less than twenty pounds.

Some of these specimens are in the hands of Prof. Marsh, and a few in the possession of Prof. Cope.

Prof. Kedzie presented a drawing representing the "Great Spirit Spring" in Mitchell County, and gave a very interesting account of the peculiarities of its waters, the singular pond formed by their flow, and of the superstitious veneration with which the springs were regarded by the Indians formerly inhabiting North-western Kansas.

Miss Annie E. Mozley read a "Catalogue of the Snakes of Kansas." The list comprises thirty-five species collected and classified at the State University.

Prof. Mudge presented a paper accompanied by drawings showing the structure of the organs of venom of the rattlesnake. The paper and drawings were prepared by L. H. Williston, of New Haven, Connecticut.

Prof. Snow presented lists of the "Insects of Wallace County;" also of the Colorado *lepidoptera.*

Prof. F. W. Bardwell, of the State University, read a paper on "Illustrations of Nebular Hypothesis." He said: Accepting the nebular hypothesis of the origin of the solar system, it has been assumed that there must have been an original motion of rotation, otherwise the solar system in condensing and contracting must have formed a single large sun without any planets revolving about it.

The question arises, whence this original rotation. It was shown that a nebulous mass of matter moving in space with a simple forward motion, must in obeying the forces of attraction from other masses of matter in space, become deflected and gradually acquire some rotary motion.

The actual velocity of rotation of the sun about its axis, and the orbital velocities of the planets serve as a means of estimating the original rotary velocity of the nebulous mass of the solar system. Such computations indicate a velocity much greater than seems to be possible by the cause of rotation first named. A second possible and probable cause of this original velocity of rotation was stated to be the collision of two such nebulous masses in space.

The necessary result of such an incident would be to develop a considerable amount of angular velocity. The remarkable appearance of several of the nebulous masses visible through the telescope is precisely that of two clouds meeting from opposite directions, the portions of which commingle and move spirally around on an axis.

The question of the probable existence of planets outside of Neptune was also suggested as connected with the nebular hypothesis; but though some considerations were named as throwing some light on the question, no positive answer could yet be given.

The evening lecture was on "The Chemistry of the Sun," by Prof. Geo. E. Patrick, of the State University. He said, solar chemistry is a new thing. Until recently nothing was known of the chemical composition of the sun; but now we have, by means of the spectroscope, determined the exact composition of the great solar body. He then exhibited a spectroscope and described the instument. It was invented about 1802. By this instrument it is shown that the vapor of different metals exhibits a line of a certain peculiarity. Applied to observations of the sun it is found that this body contains vapors of the following metals; Sodium, barium, calcium, magnesium, manganese, iron, chronium, cobalt, zinc, nickel, copper and probably gold. The gases hydrogen and oxygen are also present.

From the discoveries made the theory has been derived that the sun is surrounded by an atmosphere composed of the metals named converted by heat into a condition of rarified vapor, and that the sun itself is only a denser vapor of the same materials.

He spoke of the solar prominences, first observed during the eclipses of the sun in 1848, and afterwards in the eclipses of 1868. By these observations it was determined that one of the prominences extended at one time out from the sun a distance of 200,000 miles—a sheet of red flame. Usually hydrogen gas is only seen in the prominences, but all the other gases found on the surface are sometimes seen in the prominences.

The lecture was illustrated by the use of the spectroscope, and by charts showing its operation.

Prof. Snow, in adjourning the Academy, stated that the number of papers presented had been unusually large, showing a growing interest in the work of the academy. He congratulated the members on the fact that the institution seems moving on from year to year in a work of increased usefulness. He said the next meeting would be in June next, at Kansas City; the next annual meeting, at Topeka.

CHEMISTRY.

HISTORY OF ALCHEMY.

BY PROF. T. J. EATON.*

The whole sum of human life, from adult age to the grave, consists in a struggle for money.

Whatever may be the pursuit, whether in science, religion, production or traffic, the greatest desire of every human heart may be expressed in that one monosyllable, *gold*. It is the mainspring of human activity, the end and object for which we are all working.

"For gold the merchant plows the main,
The farmer plows the manor."

As a desire it seems almost innate, and has existed since the foundation of society. Mythology tells us that King Midas, when promised by Bacchus whatever he should ask, said "give me that with my body whatsoever I touch may be changed to gold, pure yellow gold." To-day, there is not one of us, if we had faith that it could be accomplished, that would not answer the same question practically in the same manner. It is the universal and all-absorbing problem of life, and all we know of science is considered of practical importance only so far as it enables us to wrench this precious metal from nature or our fellow man.

I mention this grand motive power of human action because its influence on the ancient scientific mind produced the strange delusion whose history I propose to give you in brief to-night.

It is full of meaning and interest, as it was the first step, the primitive stage of a beautiful modern science. Like Midas, they wished for some supernatural power by which they could, with the simple touch, change the

*Read before the Kansas City Academy of Science, Sept. 25th, 1877.

common things of earth to pure yellow gold. Their knowledge of the laws which govern matter was limited, but their fertile imaginations were unlimited. "Disdaining nature," says Youman, "they retired into the ideal world of pure meditation, and holding that the mind is the measure of the universe." They sought through its agency to work out the all-absorbing problem. They claimed at last to have discovered this power in what they called the "Philosopher's Stone" which they thought, by mere contact, would change the common metals into gold. And further, in the form of a potation, it was to prove a universal medicine, and even change the decrepitude of age into youth again and prolong life indefinitely, thus permitting the holder to enjoy his untold wealth and bask in the sunshine of perennial youth.

With this delusion before them as an incentive to investigation, we find men in those dark ages laboring day and night, searching and ransacking nature to gain from her the wonderful secret. The object for which they labored was of course never attained; but in their investigations many valuable discoveries were made, which, in after years, when the delusion was washed away by truth, were left as golden sands, with which was lain the foundation of the most beautiful, interesting and useful of modern sciences, *Chemistry.*

This class of men, searching for the philosopher's stone and the elixir of life, were called *Alchemists*, a term whose origin and primitive meaning is not accurately known. Some authors claim that it was in use among the Greeks soon after the Christian era, while others think there are sufficient reasons for considering it of Egyptian origin. But Prof. Palmer (professor of Arabic), considered it an Arabic term, being made up of the particle *al* and a word derived from the substantive *kyamon*, signifying the constitution of a thing.

There are many similar terms known to have come from the Arabic language, such as Almanack, Alkoran, Alkali, Alembic, and others, which would furnish at least strong presumptive evidence that this was the true origin of the term. Some have pretended that it is derived from the name Chem or Shem, one of the sons of Noah, and that to this day the Jews possess the art of making gold—hence their fabulous wealth.

The leading idea of the Alchemists was transmutation, or the power of changing one kind of matter to another. This idea was based on the instability of the properties of matter. They held that there were but four elements—fire, air, earth and water—and that all bodies were either hot or cold, wet or dry. Warmth and dryness, they said, produce fire. Warmth and moisture produce air. Cold and dryness produce earth, and cold and moisture produce water. These elements, fire, air, earth and water, they claimed could be transmuted into each other, by the mere exchange of properties. Thus, if dryness is added to water the moisture is destroyed and it is converted into earth. If coldness is added to air, the warmth is destroyed and it become water, an example of which was seen when an earthen vessel was filled with cold water, on a warm day; the coldness was communicated to the surrounding air, changing it to water, which was condensed on the outside of the vessel.

In like manner they claimed that earth could be changed to water, water to air and air to fire by the mere putting on or off of predominant properties. The metals they divided into two classes; such as preserved their lustre when exposed to fire, were called noble metals, while those that lost their lustre and other characteristic properties by heat, were termed base metals. The metals were moreover regarded as compounds, consisting of a metallic earth and an inflammable principle, which they called sulphur. In gold these principles were found nearly pure, while in other metals they were contaminated with foreign ingredients, by being purified of which they would be converted into gold.

Such were a few of the leading ideas of ancient chemical philosophy. To us they seem mere idle visions, but to the ancients, with the light they had on science, they were as plausible as the laws of gravitation and the correllations and conservations of force are now, and they seemed at that time strongly supported by facts.

Lead and copper ores are frequently found alloyed with silver and sometimes with gold also. Take galena (lead ore), for example. They saw by its lustre, etc., that it was a metal; if heated it gave off sulphur and its properties were heightened, in fact, it became a purer metal. It was very reasonable to suppose that by the separation of a little more sulphur it would become further purified and changed to silver, and when, on further application of heat, a little silver was really obtained, and from it, a trace of gold, it was natural to think they had produced the latter, and that by continuing or perfecting the process they could change all the lead to gold.

Again, they poured water on quick-lime; it disappeared, lost its properties as water, and acquired those of stone, in other words, it was transmuted.

A small plant in a weighed portion of soil, by the addition of pure water only, grew to be a vigorous shrub, while the soil lost but a trifle. What was more natural than to suppose the water was tranmuted to a living structure?

They said, "does not fermentation change the sweet juices of plants into the invigorating and youth-giving *aqua vitae* (water of life)." "Does not digestion transform food into blood?"

Such things seemed to amply confirm their theories, and I think their ideas, for that stage of the science, were perfectly legitimate, although in themselves erroneous. Taken in connection with the times, we find it a natural stage in the growth of the human mind; as Yauman again says "it was the first experimental grapple of man with nature."

They did not, however, adhere to this method of investigation but allowed themselves to be led astray by astrological dreams and a thousand other absurdities, the natural result of which was their fables of the philosopher's stone. This philosopher's stone or "*lapis tingens*" was then the backbone of alchemy; the distinguishing feature between it and chemistry proper. It constituted the vital part of ancient science, and, strange as it may seem, its search was continued through a period of more than a thousand years, and philosophers, during all that time, were misled by the strange delusion.

In a decree of 1423 Henry the VI of England, declared "that the clergy should engage in the search for the philosopher's stone, for, since they could change bread and wine into the body and blood of Christ, they must, also, by the help of God, succeed in trunsmuting the baser metals into gold."

The alchemists pretended that a knowledge of the philosopher's stone was allowed by Providence to only a few select persons, who were found worthy on account of a virtuous life, a careful study of alchemical authors, and perseverance in experimenting; and any one receiving this peculiar favor was threatened with the direst vengeance, both in this world and the next, if he ever revealed it to the vulgar. Their books were therefore only intended for the favored few. In their style they were as mystical and unintelligible as possible, their works abounding in symbols and diagrams to add still more to this obscurity.

From an article by Archibald Campbell we copy the following excellent description of the manner in which their followers were beguiled:

"Some of the writers adopt such mystical modes of expression, or employ such peculiar diagrams and symbols, as to be absolutely unintelligible; while others, after professing to speak plainly, and for some time employing the known terms of chemistry, suddenly disappoint our expectations. Just as we begin to flatter ourselves that we understand their processes and perceive the particular object which they have in view, they tell us that the copper or silver which they have immediately before commanded us to employ, is (*non vulgi sed nostrum*) not the copper or silver of the vulgar, but of philosophers. When after deluding their readers in this manner, they conclude by an (*intelige si potes*)—understand me if you can—or (*si plura dicerem etiam pueri intelligerent*), if I should say more even children would understand.

Thus the unhappy persons who addicted themselves to the study of Alchemy always remained uncertain how to interpret the author whom they chose as their instructor; and instead of being led from the unfortunate issue of their experiments to doubt the authority of their guide and desist entirely from the pursuit, rather supposed they had misunderstood the author, and attempted by a more attentive study of his works to arrive at his true meaning. They were thus led on from one delusive hope to another; from one expensive process to another still more expensive, till the complete expenditure of their own funds and the failure of their credit with others, forced them unwillingly to desist from their experiment. After having thus spent their lives in perpetual labor and disappointments, after having injured their health by the processes in which they were employed, and reduced themselves to absolute poverty, in their chase after an imaginary object, the alchemists were seldom cured of their folly, but indulging in retirement in their visionary speculations, they at last, either from mental derangement or from the want of funds sufficient to disprove their new theory by experiment, believed themselves to have become acquainted with the mode of forming the philosopher's stone, and composed mystical books to teach the art to others."

The first certain notices we have of the belief in transmutation was the latter part of the third or the beginning of the fourth century, when the Greek ecclesiastics, it seems, attempted to manufacture gold and silver. Many learned treatises on this subject are said to have been written by them.

After the Mahommedan conquest and the Arabians became so highly civilized, they cultivated the arts and sciences. In the eighth century this idea reappeared among them, and here we have really the first authentic mention of Alchemy. The name, as I have said before, undoubtedly originated with this people.

The Arabian physicians introduced into medicine the mercurial preparations. From their success with these agents they were led into the extravagant notion of a universal, medicine an elixir of life. These ideas seem to have been universally received at that time, and we find illustrations among their votaries—Geber, Rhazis and Avicenna.

During the intellectual darkness of the eleventh and twelfth centuries science almost faded away entirely, and we find but little known of Alchemy until about the middle of the thirteenth century, when Roger Bacon and his cotemporaries, Raymond, Lully, Albertus Magnus and Armand de Villenenne again brought it forward and made it popular, both with the ignorant and the learned. This period of Alchemical history was really the acme of the science. The most extravagant notions were entertained. They now sought for the alchahest or universal solvent, and pretended they had the power of developing the constituent principle of gems. The discovery of the philosopher's stone they supposed would not only give them the power of forming the precious metals, of curing disease and prolonging life, but it was to solve some of the most difficult problems in general science, and even in religion itself. The impetus given to the science by these earnest and probably honest alchemists continued it through the two succeeding centuries, and true believers continued their experiments with amazing assiduity.

About the beginning of the fourteenth century we find Basil Valentine, a Benedictine monk, who becomes noted as an alchemist. He has the credit of being the first man who "formally applied chemistry to medicine." He discovered the therapeutic properties of antimony, which he celebrated in a treatise entitled his "Currus triumphalis antimonii," and originated the doctrine that all substances were compounds of salt, sulphur and mercury.

The extravagant doctrines of Raymond Lully, concerning a universal medicine, were again revived and gradually gained ground until they culminated with that noted empiric, Paracelsus. This man, Theophrastis Paracelsus, was called by Nande "the zenith and rising sun of all the alchemists. He was born in 1493, near Zurich in Switzerland. His father, who was a physician, instructed him in medicine, after which he placed him under the most noted alchemists of the time. He is said to have traveled through every country in Europe, consulting physicians, quacks, old women or magicians indiscriminately, in order to gain information. At the age of twenty he was captured by the Tartars and carried before the Czar of Russia, and afterwards accompanied his son to Constantinople, where he claims he discovered the philosopher's stone. He gained a notoriety as a physician, by curing syphilis with mercury, and by the free use of opium in the cure and alleviation of disease. In the thirty-fourth year of his age he was appointed Professor of Physics and Natural Philosophy in the University of Basle. He was thus the first public Professor of Chemistry in Europe. His lectures, which attracted a vast number of students, are said to have been full of bombast and self-laudation. He treated the physicians of his time with the greatest insolence, telling them "that the very down of his bald pate had more knowledge than all their writers; the buckles of his shoes more learning than Galen or Avicenna, and his beard more experience than all their universities." He boasted of the possession of secrets which would prolong life, and even proposed himself to live to the age of Methuselah. The fact is, says one author, "he had made the discovery of alcohol, and thought that in it he had found the long sought elixir of life. Parcelsus determined to put it to the test, and drinking copiously of his alcohol (with a daring worthy a better cause) he sank dead on the floor of his laboratory."

Thus ended the days of one of the most remarkable scientific men that ever lived. While living he was degraded and mean, insolent and bombastic. He stole the opinions of others and propagated them as his own, carrying the idea of the philosopher's stone and the universal medicine to such a ridiculous extent, and then exemplifying their emptyness by his own tragic death while vainly endeavoring to prolong his life. In this he undoubtedly did much towards dispelling the illusions from the minds of thinking men.

During and for some time previous to Paracelsus there existed another class of men, a set of mountebanks, vile pretenders, who, taking advantage of the ignorance of the people, passed juggling tricks for true Alchemy. They pretended to have the philosopher's stone, and offered to impart the secret to others for a certain sum of money. One of these quacks having invested his loose change in a nail constructed one-half of gold and the other iron, and having mastered a few chemical terms, would start on his mission. Meeting an individual with more money than brains, he would carelessly draw from his pocket a handfull of nails, selecting the proper one. From a vial, said to contain the magic elixir, he would expend the last drop in converting the nail into gold. The vial contained only colored water, with which he would wash the paint off the nail. Presenting it to his victim as a sample of what he could do, he was from that moment master of his purse until it was exhausted or its owner, tired out by repeated failures in experiments, would send the charlatan away to repeat the same trick on another equally as gullible. Another sample of their swindling operations was their powder of projections. By projecting or throwing this on the surface of melted lead, they pretended it would change the lead to gold. The secret of the trick was a hollow metallic stirring rod, into which they had previously conveyed the gold. The powder was composed of sulphur, saltpetre and charcoal, which, when thrown into the crucible, made a great deflagration or flash. Stirring vigorously with the hollow rod, they would at length produce the golden grains to astonish the uninitiated.

These frauds, and finally the conduct of Paracelsus, began to alarm the higher ranks of society, so that finally the whole class of alchemists were brought into disrepute. Laws were enacted against them by different princes of Europe, and learned men discussed the falsity of the doctrine of transmutation.

As knowledge increased, Alchemy now decreased so rapidly that after Paracelsus we find but one true alchemist of sufficient note to demand our attention in this connection. This alchemist was Van Helmont, a disciple and great admirer of Paracelsus. He was born at Brussels in 1577, read medicine and received his degree at the age of twenty-two. Soon after, happening to get the itch and failing to cure himself with the regular treatment, he became disgusted with the profession and left it. Dividing his fortune among his relatives, he spent some ten years in traveling, during which time he became violently attached to the study of Alchemy, and resolved to devote the remainder of his life to its investigations. He was a blind adherent to the doctrines of his illustrious predecessor, yet he made many valuable discoveries, and his writings had sufficient merit to give him considerable celebrity. Van Helmnot may justly be considered the last of the alchemists, for with his death in 1644 the doctrine of a universal medicine expired, and soon after that of the philosopher's stone also. His cotemporaries and immediate successors were such men as Agricola, Glauber, Beguin, Glazer, Erkern, Kunkle and Boyle, who attended strictly to the refutation of those doctrines of the ancients, so that the whole alchemistical science fell to ruin, thus ending about the middle of the seventeenth century one of the most interesting and vital illusions to which the human mind has ever been subjected. It undoubtedly originated, as I have before intimated, in man's innate desire for wealth, his desire for knowledge, and a vigorous body and a long life to enjoy them, the same objects for which we are laboring to this day, viz: Gold for our purses, knowledge for our brains, and long life to enjoy both. Their labors were not entirely in vain, nor have we the right to consider their system a fraud, although fraud may have been connected with it at times. Astrology preceded astronomy, so Alchemy laid the foundation for a sublimer chemistry. In their energetic search after the philosopher's stone the alchemists made many valuable discoveries which they did not appreciate at the time, but which in after years, when collated and sifted from error, furnished the groundwork of a nobler and truer science.

THE CHEMISTRY OF GLASS.

Glass is so familiar a substance that we are likely to overlook its wonderful character. If we imagine ourselves suddenly deprived of it, and ask where we should find a substitute in many of its uses, we shall better appreciate its unique value. There is absolutely nothing known to us in nature or in art that could take its place in some of its most important applications. In our windows, for example, what could we use instead of it that would not be a mere barbarian makeshift? What dreary prisons our dwellings would be in a New England winter with no light except what could be got through oiled paper or canvas, and no opportunity of seeing anything outside without opening the window!

To the man of science the loss would be infinitely greater if not irreparable. We will not attempt to picture the dismay, the despair, of the astronomer and the chemist if deprived of the instruments and apparatus in which glass forms an essential part. It may, indeed, be asserted that the sciences could not have attained their present development without the aid of glass. The partial and imperfect substitutes that are available are so costly as to be within the means of comparatively few, and the progress of investigation would be proportionately slow and difficult.

But we must leave our readers to follow out these reflections for themselves, our present purpose being rather to give facts than to indulge in fancy pictures of the "might have been."

The manufacture of glass dates back to a pre-historic antiquity. We do not even know to what race or nation its invention is to be credited. Archæologists are disposed to assign it to the Egyptians, but apparently on no other ground than the convenient one of assuming that any art whose origin cannot be traced may safely be ascribed to a people among whom so many other arts had their rise and development. The story of Pliny that glass was the accidental discovery of some Phœnician merchants was of course a mere tradition, and it is, moreover, improbable on the face of it. He tells us that those merchants, landing on the banks of the river Belus, made use of blocks of soda to support the caldron in which they cooked their food, and that the alkali melted and united with the sand to form glass; but it is difficult to believe that an open fire on the sand would be hot enough to effect the vitrification. If the process was discovered by chance, as it may have been, it is more likely that it was connected with the early art of pottery or some of the primitive operations in the extraction of metals from their ores.

Although the art of making glass is so ancient, it is little more than half a century since the scientific principles on which it depends were explained by the Swedish chemist, Berzelius. He was the first to discover that silica is an acid, and that glass is a true chemical compound, or a salt formed by the union of this acid with alkaline bases. From that time the manufacture of glass, which had been carried on empiratically for ages, was put upon a scientific footing, and conducted with the precision of other chemical processes. The many varieties of glass that had been made acccording to arbitrary rules deduced from experience were found to be mixtures of silicate in varying proportions; or, to be more specific, mixtures of the silicate of potash or soda, or of both, with one or more silicates of the earths or metals, as those of lime, alumina, baryta, iron, lead, etc. Thus common window glass is a silicate of soda or potash, or both, with that of lime, and usually of alumina; flint glass of potash and lead, and so on. It would take whole columns of the *Journal* to enumerate the varieties of glass with their composition; but their properties depend upon a few simple chemical facts. The alkaline silicates, or those of potash and soda, are soluble in water; the others used in glass-making are insoluble. The mixtures of the two, in different numbers and proportions, vary in the power of resisting the action of acids and alkalies, fusibility, hardness, brilliancy and other respects. Lead, for instance, tends to make glass softer, more fusible, and more lustrous, which fits it for optical and ornamental purposes, but spoils it for the purposes of the chemist, who wants a hard and infusible glass, not readily acted upon by chemical agents. Lime, on the other hand, renders glass refractory and less susceptible to the action of acids and alkalies. The Bohemian glass, so much esteemed for chemical apparatus, is essentially a silicate of potash and lime.

The coloring of glass is effected by the admixture of small quantities of metallic oxides when it is in a state of fusion. Common bottle glass owes its dark-green color to the presence of oxide of iron in the sand used in its manufacture. Suboxide of copper produces a red glass, and gold a magnificent ruby tint. The oxides of antimony and uranium are used for different shades of yellow, oxide of cobalt for blue, binoxide of manganese for an amethyst purple, a mixture of the oxides of cobalt and manganese for black, and various other oxides or mixtures of oxides for the multiplicity of hues and tints required for artistic and ornamental purposes. Natural gems owe their beauty of coloring to the blending of metallic oxides with the colorless silica, and all their exquisite tints can be reproduced by the skill of the glass-maker.

The value of glass for most of its uses depends largely on the fact that it is an amorphous, that is, a non-crystalline substance. When certain varieties of glass are heated nearly to the melting point and then slowly cooled, the silicates partially separate and crystallize, and the mass becomes opaque, like porcelain. This devitrified glass, as it is called, may be restored to its original transparent state by again fusing it.

While for ordinary purposes glass is one of the most permanent of compounds, it is not so indifferent to chemical action as it appears. Water acts more or less on all kinds of glass. Faraday found that powdered plate-glass reddens moist turmeric paper, showing that a portion of its alkali is readily dissolved out. Pure water boiled for a long time in glass vessels likewise becomes alkaline. Mere exposure to moist air gradually causes a decomposition of the surface of the glass, especially when there is ammonia in the air. We have already referred to this action in an article on "Iridescence in Glass," which appeared in the *Journal* for April, 1877. According to Griffiths, a flint-glass bottle in which a solution of carbonate of ammonia had been kept for a long time was so much acted upon by the liquid that flakes of glass could be detached by shaking it.

All acids also act upon glass, especially if there is an excess of alkali in its composition, or, as already intimated, if it contains lead. Wine and other acid liquids kept in bottles have often been found contaminated with salts, resulting from the solution of the metals in the glass. Wine is sometimes put into bottles made of glass wholly unfit for the purpose, and its taste and color are affected in a very few days by the salts produced by corrosion. We can imagine that serious mischief might occasionally arise from putting up domestic wines, fruit juices, and the like in bottles not intended for any such use.

The rapid and intense action of hydrofluoric acid upon glass is due to its remarkable affinity for silica, which it separates at once from the vitreous salt, forming a fluoride of silicon. As many of our readers are aware, advantage is taken of this chemical reaction in the process of etching glass. The surface to be etched is coated with wax, and the lines to be engraved cut through with a pointed instrument. The glass is then exposed to the fumes of hydrofluoric acid, produced by the action of sulphuric acid on powdered fluor spar (fluoride of calcium), and is corroded where the wax has been removed. The experiment is one that requires special caution on account of the highly poisonous character of the acid vapor.

These are but a few out of the many facts connected with the chemistry of glass, but the length to which the article has extended forbids us to pursue the subject further at present.—*Boston Journal of Chemistry.*

NEW PROCESS FOR ELECTRO-PLATING.

Professor A. W. Wright, of Yale College, New Haven, Conn., has discovered a new and brilliant method of electro-plating, which promises to be of great utility. Taking advantage of the fact that the various metals may be volatilized by the electrical current, he provides a hollow vessel, from which the air is partially exhausted; within this vessel he arranges opposite to each other the two poles of an induction coil; the article to be electro-plated, a bit of glass for example, is suspended between the poles; to the negative pole is attached a small piece of the metal that is to be deposited on the glass. From three to six pint Grove cells are employed, yielding, by means of the induction coil, an electrical spark from two to three inches in length. Under the influence of this spark a portion of the metal of the electrode is converted into gas or volatilized, and condenses upon the cooler surface of the suspended glass, forming a most brilliant and uniform deposit. The thickness of the plating thus produced may be regulated at will, by simply continuing the action of electricity for a longer or shorter period. That the metal is actually volatilized is proven by examination with the spectroscope during the progress of the operation, the characteristic lines of whatever metal is used for the electrode being fully revealed. This may be classed as the discovery of a new art, and is certainly very interesting and remarkable. In brief, it consists in plating the surfaces of substances with metals, by exposing such surfaces to the hot vapors of whatever metal it is desired to plate with.

Professor Wright has already made a number of valuable practical applications of his discovery. He produces mirrors with silver, platinum, iron, and other metals, of the most pure and resplendent character. He deposits gold in a layer so thin that it is only 0.000183 mm. in thickness, or approximately only one-fourth the wave length of a red ray of light. He obtains curious colors in the metals, varying with the thickness of the deposits, and opens up a new field for investigation into the nature of metals and other volatilizable substances, and perhaps of light. He shows that his electrically deposited metals have improved qualities; that telescopic and heliostatic mirrors, for example, of platinum deposited on silver, by his process, will be unalterable; and the promise is that we shall before long be able by this new art to produce telescopes and other scientific instruments of greatly improved character.—*Scientific American.*

The residual charcoal after lixiviation of destructively distilled sea-weed, possesses an extraordinary power of absorbtion and deodorization. According to Mr. E. C. C. Stanford, its composition is about midway between that from wood and that from bone, in the proportion of carbon; but it is more nearly like the latter, from which it differs in containing more carbon and carbonates of calcium and magnesium, and less phosphates. It can be obtained at about one-fourth the price of any other charcoal.

Polishing Brass.—For polishing the brass work of engines, rub the surface of the metal with rottenstone and sweet oil, then rub off with a piece of cotton flannel and polish with soft leather. A solution of oxalic acid rubbed over tarnished brass soon removes the tarnish, rendering the metal bright. The acid must be washed off with water, and the brass rubbed with whiting and soft leather. A mixture of muriatic acid and alum dissolved in water imparts a golden color to brass articles that are steeped in it for a few seconds.—*Scientific American.*

Bismuth has been purified by Mr. E. Smith in this way: To every sixteen parts of bismuth kept in a fluid state, at the lower point of its fusing temperature he added one part of mixture composed of three parts of flowers of sulphur and eight parts of cyanide of potassium. The bismuth was kept melted for fifteen minutes after the mixture was introduced and then allowed to cool.

HYGIENE.

THE MECHANICS OF VENTILATION.

BY GEO. W. RAFTER, C. E.

The necessity for change of air in inhabited spaces is rendered evident by considering the sources of contamination; they are,

a. The production of carbonic acid by respiration.

b. Increase of moisture from the same cause and exhalation from the body.

c. Organic impurities from the bodily exhalations.

d. Heat thrown off from the occupants and from the lights at night; and

e. The production of carbonic acid from the lights.

The object of ventilation, therefore, is to remove foul air and substitute fresh air in place of the foul air so removed.

Ventilation, then, reduced to its simplest terms, is a matter merely of the movement of bodies of air; and, since air in a substance possessing weight, the whole question is one of mechanics, and is in the fullest sense susceptible of numerical computation.

This being granted, further progress is comparatively rapid, consisting (1) of the development of the laws of air in motion, and (2) in the application of those laws to the removal of foul air, and the consequent supplying of fresh air in buildings and closed structures generally.

Before entering upon the strictly mechanical portion of the subject, it will be well to consider briefly (1) the nature and extent of the contamination rendering change of air in inhabited confined spaces necessary, and (2) the collateral head of ventilation—warming.

a. Production of carbonic acid by respiration. When air passes into the lungs it undergoes a chemical change whereby a certain amount of carbonic acid is produced. This when expired adds to the impurity of the air, and were its production in respiration continued a sufficient time in any tight space, the air would immediately become so impure as to produce death. It has been found by experiment that air in its normal condition contains in all parts of the world an amount of carbonic acid equal to from three to four volumes in 10,000. That some must exist in the air will be readily inferred by considering that respiration and combustion produce this gas. The amount, however, was only determined by the researches of Regnault, who analysed air from many localities. When carbonic acid is the only impurity from eight to ten volumes in 10,000 may be respired without serious inconvenience, though six volumes in 10,000 is taken as the limit of good ventilation for reasons to appear hereafter. An adult produces 0.6 of a cubic foot of carbonic acid per hour.

b. Increase of moisture from respiration and bodily exhalations. The amount of moisture present in the air at different times varies greatly. Observation shows that there are certain amounts of moisture which when exceeded lead to a rapid deterioration of the air. From 4.5 to 5.0 grains in a cubic foot of air at 60°–62° is the limit of good ventilation.

c. Organic impurities from the bodily exhalations. There is always present in illy-ventilated apartments, especially school-rooms where children from the poorer classes are present, a certain unpleasant smell which a medical friend of large experience in ventilation characterises as "cheesy." In simple justice it must be said that this smell is by no means confined to school-rooms of the kind indicated. Excellent examples of it are frequently noticed in concert halls, theatres, lyceums, and in private houses where even an intimation of uncleanliness would be a rank injustice. Organic analysis has thus far been unable to do more than detect the simple presence of this ill-smelling enemy of the human race. It has been found, however, that a rapid increase of the organic impurity takes place when carbonic acid exceeds six volumes in 10,000, or when moisture rises above five grains in a cubic foot of air at 60°–62°. The reason for the limit of carbonic acid and moisture as above given is therefore apparent.

d. Heat thrown off from occupants and from the lights at night. It has been determined by observation that an adult gives out 470–490 units of heat per hour, and that an ordinary sperm or tallow candle gives out in burning one hour substantially the same amount. The specific heat of air is 0.238 when water is taken as unity, consequently the heat from a single person or single candle in one hour would raise 1074 lbs. of air 1°, or, since, a pound of air at 60°–62° equals thirteen cubic feet (exactly 13.09 at 60°) we have heat enough to raise 25,662 cubic feet 1°. It will be shown, hereafter, that 2000 cubic feet of air per hour is a fair allowance for an adult. It follows that every person, and every candle, gives out heat enough in an hour to raise the supply per hour for each person, from 12° to 13°. If a room were constructed of a capacity equal to say ten persons, and the air supply exactly regulated to give each 2000 cubic feet per hour, the bodily heat alone would increase the temperature of the supply from 12° to 13°.

A large majority of buildings are now lighted by coal gas; we will, therefore, consider the amount of heat produced by the combustion of a cubic foot, having ascertained which it will of course be easy to calculate the elements for rooms of any given capacity and number of lights.

The average of a large number of analyses of coal gas of from twelve to eighteen candle power is as follows:

Hydrogen,	43.76
Marsh Gas,	40.47
Carbonic Oxide,	5.94
Olefiant Gas,	6.58
Nitrogen,	1.05
Oxygen,	0.47
Carbonic Acid,	0.75
Aqueous Vapor,	1.00
	100.02

The specific gravity of sixteen candle power gas is approximately 0.450, common air at a temperature of 60° being unity. A pound of air at 60° contains exactly 13.09 cubic feet; consequently, a pound of coal gas of a specific gravity 0.450 and at the same temperature contains:

$$\frac{13.09}{0.450} = 29.09 \text{ cubic feet.}$$

A cubic foot ot such gas therefore weighs

$$\frac{1.00000}{29.09} = 0.0343 \text{ pounds.}$$

Taking the percentage of the constituents of coal gas as given above, we have the following for the weight in pounds of each in a cubic foot of gas:

Hydrogen,	0.01501
Marsh Gas,	0.01388
Carbonic Oxide,	0.00203
Olefiant Gas,	0.00225
Nitrogen,	0.00036
Oxygen,	0.00016
Carbonic Acid,	0.00025
Aqueous Vapor,	0.00034
	0.03428

Multiplying each of these weights by the caloric modulus for the corresponding element and we have the number of heat-units evolved in the combustion of that element, and the sum of these units will be the theoretical heat obtained by the combustion of a cubic foot of gas. The calculation referred to the Fahrenheit scale will stand as follows:

Hydrogen,	$34462 \times 0.01501 \times 1.8 =$	931.09
Marsh Gas,	$13063 \times 0.01388 \times 1.8 =$	326.36
Carbonic Oxide,	$3403 \times 0.00203 \times 1.8 =$	12.42
Olefiant Gas,	$11657 \times 0.00225 \times 1.8 =$	48.00
		1317.87 heat units.

The remaining constituents are non-combustible.

The caloric moduli for the different gases as here used were obtained by combustion in an atmosphere of pure oxygen, while combustion in practice will, of course, take place in common air. Comparing this calculated amount of heat with the observed amount, obtained by calorimetrical tests of illuminating gas of the candle power and specific gravity above given, shows that a reduction of the calculated heat of forty per cent. is necessary to make calculation agree with experiment. This reduction is undoubtedly owing largely to imperfect combustion, in addition to difference of condition. Making such reduction we have $1317.85 \times 0.6 = 790.7 =$ approximate number of heat-units from the combustion of one cubic foot of sixteen candle power illuminating gas.

The mean of several tests was 705 heat-units per cubic foot of gas. We will take, for purposes of calculation, 750 heat-units per cubic foot of gas.

Gas burners range from three to six cubic feet consumption per hour, and, where no special arrangements are made for removing the heat and products of combustion from the burners, a simple calculation will show the great influence upon the health of the occupants of an apartment exerted by this apparently insignificant source of contamination.

e. The production of carbonic acid from the lights. According to many careful experiments the carbonic acid from a sperm or paraffine candle equals 0.31 of a cubic foot per hour. Calculation based upon the average composition of coal gas shows that the combustion of a cubic foot of gas produces 0.43 of a cubic foot of carbonic acid. Such a calculation stands substantially as follows: Taking the average analysis of coal gas given above, we have by calculation from chemical equivalency the weight of carbon in a cubic foot of gas, and from this we derive the weight of oxygen necessary to convert that amount of carbon into carbonic acid. The weight of the carbon, plus the weight of the oxygen, equals the weight of carbonic acid produced, and is found to be 343 grains. Density of carbonic acid gas is 1.5 at a temperature of 60°. A cubic foot weighs at that temperature 801 grains, a cubic foot of air weighing 534 grains at that temperature. Dividing the weight of a cubic foot of carbonic acid by the weight of that gas from a cubic foot of coal gas, and we have 0.43 of a cubic foot as the amount of carbonic acid produced by the combustion of a cubic foot of coal gas.

It is evident then that a considerable amount of oxygen is required for the various processes of respiration and combustion going on in confined spaces, and that a further deterioration of the air is continually taking place by reason of the presence of the nitrogen previously mixed with the oxygen so removed; that is to say, oxygen the life-supporting agent in these various processes is continually being removed, while nitrogen the inert, useless element is left behind. Air in its normal condition contains twenty-three per cent. by weight of oxygen, and seventy-seven per cent. of nitrogen. It will soon result, however, in any confined space where respiration and combustion are going on, that the amount of oxygen constantly decreases while nitrogen and carbonic acid increase relatively to the amount of oxygen present.

A farther source of contamination is found in insufficient sewer connections, though this part of the subject has been so often discussed that it is unnecessary to consider it at length here.

According to General Morin's paper on warming and ventilation, a translation of which appears in the annual reports of the Smithsonian Institution for 1873–4, heating apparatus should be fuel considered in three different respects: 1—In regard to economy of fuel. 2—In regard to effect on health. 3—In regard to comfort.

The nature of the service to be performed should always be considered in deciding upon the apparatus for fulfilling these considerations. For instance, where occupancy is at intervals, and then only for a short time, the first will decide the choice of method. In buildings occupied more or less continuously, the second consideration should have more weight, while in dwelling houses the second and third together should influence the choice.

The cheapest method of heating is by stoves, more than ninety per cent. of the heat being realized in this way. The first cost is also much less than by the other methods.

Comfortable and healthful heating is obtained by open fire-places, two types of which may be distinguished: 1—Ordinary fire-places. 2—Ventilating fire-places.

The ordinary fire-place takes its supply of air directly from the room and heats solely by radiation. Its heating effect does not exceed fourteen per cent. of the total amount of heat produced. It is healthful and comfortable but not at all economical.

Captain Galton, of the British army, invented a form of the ventilating fire-place which furnishes a very satisfactory solution of the problem of pleasant, healthful heating, combined with excellent ventilation. It consists of a grate with a flue leading therefrom as in the ordinary arrangement. The flue, however, is of a good conducting and radiating material, and passes up through an exterior flue, into which air is admitted from the outside at the back of the grate. This air is warmed by coming in contact with the interior flue, which gives it an upward tendency, and is withdrawn near the ceiling into the room in which the fire-place is located, or it may be conducted into the rooms of the second story. The air to support combustion is taken from the room warmed as in the previous plan. The heating effect realized by this method is thirty-five per cent. of the total heating power of the fuel.

Heating by steam or hot water is pleasant, and when in connection with proper ventilation exceedingly healthful. The heating effect realized is nearly ninety per cent.

Hot air, when properly regulated, is pleasant, and in connection with ventilation, healthful. Heating effect seventy-five per cent.

At a temperature of 60°, 13.09 cubic feet of air weigh exactly one pound. A cubic foot at the same temperature weighs 534 grains. As already remarked, air in common with all other ponderable bodies obeys the laws of gravitation, and, because of the slight attraction between its particles, it is, like gases generally, extremely sensitive to changes of temperature or pressure. * * * * * * * *

According to the law of physics, known as the principle of Archimedes, *a body plunged into a fluid loses a part of its weight equal to the weight of fluid displaced.* This law may apply to three different cases:

1.—The weight of the body may exceed the weight of the fluid displaced, or in other words, the mean density of the body may be greater than that of the fluid; in this case the body sinks.

2.—The weight of the body may be less than that of the fluid displaced; in this case the body rises partly out of the fluid until the weight of the fluid displaced is equal to its own weight.

3.—The weight of the body may be equal to the weight of the fluid displaced; in this case the two opposite forces being equal the body is in equilibrium and remains in any position in which it may be placed.

We will consider the application of these laws in the case of common air, considering at first a single cubic foot.

It has been shown, that at a temperature of 32°, and under a pressure of 29.92 inches of mercury, every cubic foot of air weighs 0.081 pound. While the temperature of the single cubic foot remains at that point we have, by case 3 above, a condition of equilibrium, and no movement or disturbance takes place, since an equivalent volume of the surrounding air has exactly the same weight.

Suppose, however, the temperature of the air is at 70° and that by coming in contact with some cold surface, as, for instance, a window pane, the temperature of the single cubic foot is reduced to 32°. The result of such reduction is by the preceding discussion threefold: 1—Volume reduced. 2—Density increased. 3—Consequently it becomes heavier than surrounding air and tends to fall by a certain definite weight. * * *

The cubic foot of air in passing from the temperature of 70° to that of 32°, increases its weight by 0.081—0.0752=0.0058 pounds. Carrying this calculation into grains, we have weight at 70°=7000×0.0752=526.4 grains, weight at 32°=7000×0.081=567.0 grains, 567.0—526.4=40.6 grains=gain in weight of a cubic foot of air by reduction of temperature from 70° to 32°.

In cold weather, when the windows and outside walls are much colder than the general temperature inside, it is evident from the preceding that currents of air must be continually passing downward to the floor along such cold surfaces.

Suppose, farther, the air is at a temperature of 40° and by coming in contact with a heated surface is warmed to 98°. Density at 40°=0.0797 pounds. Density at 98°=0.0714 pounds. Or, a cubic foot in passing from temperature 40° to that of 98° loses weight by an amount equal to 0.0797—0.0714=0.0083 pounds=7000×0.0083=58.1 grains. Our particular cubic foot of air is then in the condition of case 2 of the principle of Archimedes. Its tendency is to rise and it continues doing so when unconfined, until a point is reached where the densities are again equal.

The temperature of the human body is 98° while 40° is about an average temperature of the air during the whole year. It is evident, therefore, that a ventilation of the body is continually taking place through the operation of natural causes. We should take advantage of the hint thus obtained from nature, and plan the ventilation of our dwellings and public buildings upon a more rational basis than at present seems to prevail.

It is evident, without special discussion, that movements similar to those just ascribed to the particular cubic foot of air are, in fact, constantly taking place throughout the whole atmosphere, not only out of doors but in as great a degree inside. The atmosphere, considered as a whole, can never be at rest, the slightest changes in temperature produce variations in volume, density and pressure, and these again are the causes of unending motion. In short, we may say the air is perpetually in unstable equilibrium.

The temperature at which inhabited spaces should be kept varies from 60° to 65°, depending to a considerable extent upon the nature of the operations carried on. It is certain, moreover, that the temperature can be kept lower without discomfort in well ventilated apartments, than in those which are not well ventilated. Upon this point the writer has recently made some investigations which may with propriety be introduced here.

The revised charter of the city of Rochester, of last year, created a Board of Health with more extended authority than that exercised by previous boards. Among other items the new board has authority to regulate the ventilation of public school houses throughout the city. During the past winter the writer at the instance of said board made an extended examination of all the school buildings to the number of twenty-five, and reported thereon at length. In the course of the examination it appeared necessary to ascertain exactly the temperature at which the several rooms were kept. In going through them and using a thermometer in each it very soon became apparent that there were extraordinary variations in the temperature. The school-rooms, numbering more than 200, were then supplied with thermometers, and the teachers carefully instructed as to the manner of taking observations, &c. The observations were taken ten times a day for one week, the times of taking being as follows: At the beginning of school, (9 A. M.); at end of first hour, (10 A. M.); before morning intermission, (10.45 A. M.); after morning intermission, (11 A. M.); at end of morning session, (12 M.); at beginning of afternoon session, (1.30 P. M.); end first hour, (2.30 P. M.); before intermission, (2.45 P. M.); after intermission, (3 P. M.); end of afternoon session, (4 P. M.)

These observations in connection with a careful consideration of the facilities for ventilation furnished matter of the highest interest. They led, indeed, to the inevitable conclusion that in school houses where the ventilation is thorough, pupils and teachers are perfectly comfortable at a temperature of 60°–62°, and that the temperatures invariably increase as perfection of ventilation decreases. So true is this that the following laws are fairly deducible, which so far as an inquiry into the ventilation of school houses is concerned, may be denominated the laws of temperatures.

1. In rooms having but one outside exposure he temperature is uniformly higher than in those having two or more outside exposures, other conditions being the same.

2. Where the communication is direct by means of roomy halls between lower and upper floors, the temperature ranges higher on upper floors.

3. Of two rooms having equal exposure and equal heating and ventilating facilities, the one containing the greater number of pupils will show the higher average temperature.

4. There is a relation between inside temperature, outside temperature and outside humidity, which relation appears to be expressed by saying that inside temperature varies directly as outside humidity and inversely as outside temperature.

The writer cannot at present vouch for the entire correctness of this last law; the observations were somewhat conflicting, though the preponderance is decidedly in favor of the law. It stands at present, however, as an inference rather than a positive induction.

The temperatures show invariably an increase from beginning of school in morning (9 A. M.) to end of first hour (10 A. M.). They also show a corresponding increase from beginning of school in afternoon (1.30 P. M.) to end of first hour (2.30 P. M.). In buildings of no ventilation, and where, during the winter, flushing with fresh air is resorted to by opening windows at intermissions, the thermometers were naturally lower after intermission than before; while in those where flushing is not resorted to, the temperatures were substantially the same. The maximums were usually obtained before intermission and at end of session. Observations on humidity were also taken in several of the buildings, and it was found that a great increase of moisture in excess of that outside took place in poorly-ventilated rooms, pointing to the conclusion that excess of temperature is accompanied by excess of moisture, and to the farther consideration that excess of temperature and excess of moisture are certain indications of defective ventilation.

Judging from the showing of the temperature records a great difference of opinion exists as to the proper temperature at which a room should be kept. The rooms are undoubtedly kept at the point of comfort and that point varies as perfection of ventilation varies. For instance, the lowest temperatures occur in well-ventilated rooms, while the highest occur in those poorly ventilated. In rooms where the temperature ranges from 62° to 66° the question was asked of the teachers in at least twenty places, "Do you find the room too warm when much above 66°?" The reply usually was, "We do." In the case of rooms with an average temperature of 68°–71° the form of question was, "Do you find the room too cold when much below 68°?" The reply was in nearly every case, "We do." The general principle, therefore, is, in imperfect ventilation the exhalations from the body and breath produce an excess of moisture in the air, and, consequently, an increase of relative humidity. Our sensations of heat and cold depend (within limits) as much upon the amount of moisture present in the air as upon the actual temperature. A high relative humidity always produces chilliness. We instinctively, therefore, increase the heat as the moisture increases. Moreover the air's capacity for moisture increases as the temperature. In illy-ventilated apartments, the two go together, increase of moisture leading to increase of heat, increase of heat leading to increase of moisture. Aside from the mere waste of heat resulting from this condition of affairs, there is matter of more serious import to be considered. Where bad ventilation exists the windows and doors are thrown wide open for flushing at intermissions and noontime. These results are immediate depression of temperature, in some cases sufficient to fall below the dew point, hence moisture is actually deposited as dew about the room, and hence colds and sickness of teachers and pupils generally. The same thing will occur not only in school rooms, but in any illy-ventilated apartment where a large number of people being congregated, windows are suddenly opened for the admission of fresh air.

The question of humidities is somewhat complicated. It will be eminently proper, therefore, to consider briefly the principles involved; and in making such consideration Deschanel's Physics will be drawn upon. With this general acknowledgement such use is made of the excellent work in question as may be necessary to the proper elucidation of the subject in hand.

The condition of the air as regards moisture involves two distinct elements: (1) the amount of vapor present in the air, and (2) the ratio of this to the amount which would saturate the air at the actual temperature. There are two important laws bearing upon the subject:

1. The weight of vapor which will enter a given space is the same whether this space is empty or filled with a gas.

2. When a gas is saturated with a vapor the actual tension of the mixture is the sum of the tensions due to the gas and the vapor separately; that is to say, it is equal to the tension which the gas would exert if it alone occupied the whole space plus the maximum tension of vapor for the temperature of the mixture.

The word tension means in this connection the force acting to produce expansion, as opposed to pressure, or the force tending to produce compression, or we may say the tension decreases the density of a gas while pressure increases that element.

Relative humidity is defined as the weight of aqueous vapor in a given volume of air, expressed as a percentage of the weight of vapor at saturation which would occupy the same volume at the actual temperature.

When air containing water in form of vapor is gradually cooled at constant pressure, its capacity for vapor gradually decreases until the point of saturation is reached. Any farther reduction of temperature is accompanied by a deposit of moisture. This point of deposit is called the dew point, the relation of which to the actual temperature is shown by the humidity tables below.

There is a popular idea that air loses its moisture by heating. In fact, since moisture exists in the air, so far as known in the form of vapor and not mechanically suspended, the only way the air can lose moisture is by reduction of temperature to the dew point, and by consequent deposition in the form of dew. The effect of heating air is to increase the capacity for moisture, accompanied by decrease of relative humidity, an apparent dryness may be thus attained, although the absolute humidity remains the same as previous to the heating. * * * * * *

According to General Morin, the amount of air to be changed every hour, in order to keep within the limits of good ventilation, is as follows:

		Cubic feet.
Hospitals,	2.119	3.709
Prisons,		1.776
Workshops,	2.119	3.532
Barracks,	1.059	1.776
Theatres,	1.413	1.776
Lecture and assembly rooms, &c	1.059	2.119
Schools,	.424	1.059

Having decided how much air shall be supplied per unit of time, the next question is how shall the supply be furnished?

Two methods of producing the result may be distinguished, the vacuum and plenum. We confine ourselves entirely to a consideration of the former, as being more in accordance with the natural order of affairs, and as having been demonstrated by experience to give the better results.

The vacuum method requires that every apartment or building shall have, suitably connected with it, a vertical shaft, in which an exhaust draft is constantly maintained. The problem in hand, then, is the determination of the dimensions of such a shaft and its contingent connections, together with such special considerations as shall make the method applicable to any case whatever.

The points of withdrawal will be as near the source of contamination as convenient, that is, at or near the floor. They should never be in the floor itself, as dust, etc., will collect, ultimately causing unpleasant stoppages. The points of ingress, should on the contrary, be as far away from the contamination as possible, or at the ceiling. It may be taken as a general law that whatever the method of heating resorted to, foul air should be drawn out of a room by creating a vacuum at some point in the side walls near the floor, while fresh air should be introduced at or near the ceiling.

We have seen that heating a limited amount of air to a temperature higher than the surrounding atmosphere causes the heated portion to ascend. This then offers in many cases a cheap and efficient means of ventilation, by simply utilizing the large amount of heat now wasted through the chimneys. It should be noticed in passing that although there is a great waste of heat at present through the chimneys, it seems certain that improved ideas of chimney building will soon in a great degree correct that evil. In the meantime, the ventilation of structures already erected may be improved by taking advantage of the method here indicated. * * *
—*Van Nostrand's Engineering Magazine.*

ERUPTION OF THE TEETH.

BY A. H. TREGO, D. D. S., KANSAS CITY, MO.

It is lamentable that many of the important points connected with the physical development of children are carelessly regarded and poorly understood by parents generally.

Physical perfection cannot be attained without perfect health; health can be had only by perfect digestion; perfect digestion only by perfect mastication, and perfect mastication only by perfect teeth.

In this age of scientific development there is no reasonable excuse for children growing up with poor teeth. It is outrageous. *Cleanliness* is the great preventive, and, considering the American mode of living, no child should pass its fourth year without being taught that it is as essential to brush the teeth as to be washed and combed. The deciduous (first) teeth are as liable to decay as are the permanent set, and the premature loss of the first is vitally detrimental to the permanent.

Every mother should be familiar with the following schedule of periods of dentition.

DECIDUOUS TEETH.

Central incisors	5 to 8 months.
Lateral "	7 to 10 "
First molars	12 to 16 "
Canines	15 to 20 "
Second molars	20 to 36 "

PERMANENT TEETH.

First molars	5 to 6 years.
Central incisors	6 to 8 "
Lateral "	7 to 9 "
First bicuspids	9 to 10 "
Second "	10 to 11 "
Canines (eye teeth)	11 to 12 "
Second molars	12 to 14 "
Third "	17 to 21 "

The lower teeth generally precede the upper by two or three months.

If the eruption and articulation are irregular, apply to a careful and reliable dentist for advice.

The upper and lower teeth correspond in number, character and general form, there being two of each name in either jaw, rights and lefts.

The teeth stand in rotation, and signify as follows: Incisors, for cutting; Canines, for tearing, like the tusks of a dog; Bicuspids, for tearing and grinding; Molars, for grinding, as a mill.

Grinding the food does not constitute mastication. The act of chewing superinduces and increases the flow of saliva, without which proper deglutition and digestion are impossible.

Persons generally suppose the First Molars of the permanent set to be inciduous. Don't forget that they are permanent, and, as it were, the corner-stones of the mouth and face, and should never be allowed to require extracting. In every eighty cases in every one hundred these First Molars are decayed in the interstices before the child passes its eighth year, and if not filled while the cavity is small, the cavities quickly reach the pulp (nerve) and produce the most intense suffering, and if extracted, butchery and malformation. Parents who neglect their children's teeth deserve uncompromising censure.

GEOLOGY.

On Critical Periods in the History of the Earth, and their relations to Evolution; on the Quarternary as such a Period.

BY JOSEPH LECONTE.

Read before the National Academy of Sciences, April 18, 1877.

In the series of rocks representing the history of the earth there occur at different horizons *uncomformities.* In most cases these are not found at the same horizon in different places; but there are a few which seem to be very general. Associated with these unconformities, as is well known, there is nearly always a marked change in the fossil species. The greatness of this change is invariably in direct proportion to the generality of the unconformity. These general unconformities attended with very great changes in organic forms are the natural boundaries of the great divisions of time, and the less general unconformities attended with less sweeping change of organic forms, of the subdivisions of time.

The earlier geologists, under the influence of the *then* dominant idea of frequent supernatural interference with the course of nature, imagined that these unconformities marked the times of instantaneous cataclysm which disturbed the rocks and destroyed all living things, sometimes locally, sometimes generally. and that these exterminations were followed by re-creations of other and wholly different species at the beginning of the subsequent period of tranquility. *Now,* however, we believe that no such instantaneous general exterminations and re-creations ever occurred. We know that unconformity simply indicates eroded land-surface, and therefore marks a period of time during which the observed place was land and received no sediment; that two series of rocks unconformable to each other denotes two periods of comparative quiet, during which the observed place was sea-bottom, receiving sediment steadily, separated by a period of oscillation producing increase and decrease of land, during which the observed place was raised into land-surface, with or without crumpling of the strata, deeply eroded, and then sunk again below sea level to receive the second series of strata. The length of the two periods of repose is roughly measured by the thickness of the two conformable series. The length of the period of commotion is roughly measured by the amount of erosion at the line of unconformity.

Evidently, therefore, every case of unconformity marks a period of time —often a long period—during which there was no record made in strata and fossils at the observed place; certain leaves—frequently very many —are there missing from the Book of Time. Is it any wonder, then, that skipping over these pages when we commence reading again we find the matter entirely new? Evidently the suddenness of the change in organic forms is only apparent. If we could recover the record, which was doubtless carried on elsewhere, the break would disappear; if we could find the missing leaves the reading would be continuous. In every such instance, therefore, there is a *lost interval* of history. In cases of local unconformity we recover the lost record in other places, and thus fill up the blank in the history. But in some cases of very general unconformity, such as those which mark the great divisions of time, the loss is not yet recovered, perhaps is irrecoverable, though doubtless the more complete knowledge of the geology of the whole earth surface will go far toward filling blanks and making the record continuous.

The view above presented is now held by all geologists, but there seems to be danger under the influence of the *now* dominant views of evolution, of erring on the other extreme. Assuming a *uniform rate* of evolution, many, it seems to me, commit the mistake of measuring the amount of lost interval by the amount of change of organic forms, and thus discredit the real value of the geological record by exaggerating greatly its fragmentary character. On the contrary, there appears good reason to believe that the evolution of the organic kingdom, like the evolution of society and even of the individual, has its periods of *rapid movements* and its intervals of *comparative repose* and re-adjustment of equilibrium. Geological history, like all other history, has its periods of comparative quiet, during which the forces of change are gathering strength, and periods of revolution, during which the accumulated forces manifest themselves in conspicuous changes in physical geography and climate, and therefore in rapid movement in the march of evolution of organic forms—periods when the forces of change are *potential*, and periods when they become *active*. Conformable rocks represent the intervals of comparative quiet, during which organic forms are either permanent or change slowly; unconformity represents a time of oscillation, with increase and decrease of land, and therefore of rapid changes of physical conditions and correspondingly rapid movement in evolution. The general unconformities, of course, mark times of very general commotion—of widespread changes of physical geography and climate, and consequently of exceptionally rapid and profound changes in organic forms.

These periods of revolution in all history are *critical*, and hence are of especial interest to the philosophic historian and to the evolutionist; but they are also in all history periods of *lost record*. And as in human so also in geological history—the farther back we go the longer are the lost intervals and the more irrecoverable the lost records. We will now give examples of such lost intervals, and show their significance in evolution.

The first and by far the greatest of these is that which occurs between the Archæan and the Palæozoic. In every part of the earth where the contact has yet been observed the Primordial lies unconformably on the upturned and eroded edges of the Archæan strata. This relation was observed first in Canada, then in various parts of the United States, then in Scotland, the Hebrides, Bavaria, Bohemia, Scandinavia. Unconformity in such widely separated localities indicates wide-spread changes in physical geography, and therefore, presumably, of all those physical conditions included in the word *climate*. These changes of physical geography are best illustrated in the United States. The break between the Archæan and the Primordial has been observed in very many places all over the wide area of the United States, east and west: not only in Canada, in New York, in the Appalachian region, in Wisconsin, Missouri, Arkansas and Texas, but also all over the Rocky Mountain region, in Nebraska, Montana, Idaho, Wyoming, Colorado, Utah, Nevada, New Mexico and Arizona. As upturned, eroded, outcropping strata mean land surface, it is evident that there was at that time *a very large area or else several large areas of land* in the place now occupied by the American continent. In comparison with the subsequent Silurian it was *a continental period*. This land is often spoken of as *Archæan land*. It was indeed land of *Archæan rocks*, but for that very reason not of Archæan times, for these rocks were, of course, formed at the bottom of the sea in Archæan times, and therefore these localities were all sea-bed receiving sediment at that time. We know absolutely nothing of the land of Archæan times, and never can know anything until we find still older rocks, from the *debris* of which Archæan sediment was formed. The land spoken of above was *land of the Lost Interval*. That the interval was immensely long is evident from the prodigious erosion. That it was a period of wide-spread oscillation is also apparent, for all the places mentioned were sea-bed in Archæan, land during the interval, and again sea-bed during the Silurian. But of this long interval not a leaf of record remains.

Evidently, then, at the end of the Archæan an enormous area of Archæan sea bottom was raised up and crumpled, and became land. After remaining land for a time sufficiently long to allow enormous erosion of crumpled strata it again went down to the old Primordial shore line, and the Silurian age commenced. This time of elevation is the lost interval.

Now, when the record closed in the Archæan, as far as we know, only the lowest forms of Protozoan life yet existed. The beginnings of life had not yet differentiated into what might be called a fauna and flora. When the record again opened with the Primordial we had already a varied and highly organized fauna, consisting of representatives of many classes and of all the great types of animal structure except vertebrates. Nor were these representatives the lowest in three several departments, for Trilobites and Orthoceratites can hardly be regarded as lower than the *middle of the animal scale* as it now exists. It is certain, therefore, that all the great departments except vertebrates, and most of the classes of these departments, including animals at least half-way up the animal scale, were differentiated during the lost interval. The amount of evolution during this interval cannot be estimated as less than all that has subsequently taken place. Measured by the amount of evolution, this lost interval is equal to all the history of the earth which has since elapsed. We escape this very improbable conclusion only by admitting *a more rapid rate of evolution during critical periods.*

It is one of the chief glories of American geology to have first established the Archæan as one of the primary divisions of time. It is even yet reluctlantly admitted as such by many European geologists. And yet it is seen that from every point of view, whether of the rock system or of the life system, it is by far the most widely and trenchantly separated of all the eras.

The next greatest lost interval (though far less than the preceding) is that between the Palæozoic and the Mesozoic. Here we have the next most general unconformity, indicating the next most wide-spread changes of physical geography and climate, accompanied by the most sweeping changes in organic forms, not only in species and genera, but also in families and orders. This change is the more striking as it occurs in the midst of an abundant life. It is the greatest and most general change in the forms of organisms which has ever occurred in the history of the earth. *It took place, again, during a lost interval.* A portion of the loss is recovered in the Permian, but the most critical time, the time of most rapid change, namely, that between the Permian and the Trias, is still missing. How we long to find the steps of this great change! What a flood of light would it shed on the process of evolution! But although the change in the organic kingdom was, just here, so enormously great, yet the lost interval does not seem very long, for in England the Trias and Permian seem to be conformable, though probably with change from marine to fresh-water conditions. It is hence impossible to resist the conclusion that the steps were just here fewer and longer and the progress more rapid than usual. As in human history, revolutions are the times of the birth of new social ideas, upon which, during the subsequent period of tranquility, society is readjusted in prosperity and happiness on a higher plane, so also in geological history, critical periods are times of origin of new and higher organic forms, and the subsequent periods of tranquility are times of readjustment of equilibrium and prosperous development of these forms.

Like the previous lost interval, this was also a period of oscillation—a period of great increase of land, which was again partly submerged to inaugurate the Trias. It was, therefore, also *a continental period.* The land-making commenced at the end of the Coal period, in this country with the formation of the Appalachian Mountains, continued through the Permian, and culminated in the lost interval, which is, in fact, for that very reason lost.

Far less in length of time and perhaps in the sweeping character of the change of organisms, but far more important and interesting on account of the high position of the animals involved, is the lost interval between the Mesozoic and Cænozoic. The length of time lost here is comparatively small. In America, in many parts of the West, the uppermost Cretaceous seems to pass into the lowermost Tertiary without the slightest break of continuity. There may be some break, some unconformity, some lost record, but certainly it cannot be large. Yet the change, especially in the higher animals, is immense. In America the break and the lost interval is much greater between the Jurassic and Cretaceous than between the Cretaceous and Tertiary, still the organic change is far greater in the latter case. The reason is that the changes of physical geography and climate in the latter were *more general.* Although in America the break and the lost interval is greater at the end of the Jurassic, yet, taking the strata all over the earth, the break is far more general at the end of the Cretaceous; ~~and~~ it is these *general* changes in physical geography which affect climate the most, and which, therefore, produce the profoundest changes in organic forms.

Now it is almost impossible to imagine a clearer proof of the fact of rapid evolution-movement during critical periods than we find in the shortness of the lost interval and the greatness of the change in higher organisms just at this horizon in the rocky series. Nothing can be more astonishing than the abundance, variety, and prodigious size of reptiles in America up the very close of the Cretaceous, and the complete absence of all the grander and more characteristic forms in the lower Tertiary, unless, indeed it be the correlative fact of complete absence of mammals in the Cretaceous, and their appearance in great numbers and variety in the lowest Tertiary. If Cretaceous mammals existed in *America,* surely their remains would have been found in the wonderfully rich Cretaceous strata. It seems certain that in America, or at least in that portion which has been examined, mammals appeared somewhat suddenly and in great numbers on the scene, and were a principal agent in the extermination of the large reptiles. The wave of reptilian evolution had just risen to its crest, and perhaps was ready to break, when it was met and overwhelmed by the rising wave of mammalian evolution.

We have dwelt only on the great change in the higher classes, but the change really extended to all classes. This was, therefore, a time of exceptionally general and rapid changes in all departments alike. In other words it was a critical period in organic evolution.

That it was also a time of very extensive changes in physical geography here in America, as well as elsewhere, is well known. The Cretaceous sea, which extended from the Gulf of Mexico to the Arctic Ocean, covering the whole western plains and plateau region, and thus dividing the American continent into two—an eastern Appalachian continent and a western or basin region continent—was abolished at the end of the Cretaceous, and replaced by great fresh-water lakes in the same region, and the continents became one. Moreover, it is probable that it was a period of widespread oscillation, that is, of upheaval and again of subsidence to the condition of things found at the beginning of the Tertiary. It is probable that the upheaval which destroyed the Cretaceous sea went much beyond the condition of things afterwards; that just at this interval the land was higher and larger than in the Tertiary; that, in short, this was again a *continental period*, and probably a period of greater cold than the subsequent Tertiary.

The change in physical geography, then, was immense, but in most places by bodily upheaval, not by crumpling of the strata; and therefore the usual sign of such change, namely, unconformity, is often wanting. The change of climate all over the American continent was no doubt very great, and the change in organic forms correspondingly great everywhere and in all departments; but this was especially true of all water-inhabiting species in the region of the old Cretaceous interior sea, for here there was a transition, not only in climate but from salt to fresh water through the intermediate condition of brackish water. The Cretaceous marine species rapidly disappeared, partly by extermination and partly by transmutation into fresh-water species, as has been observed, recently, to take place in some crustaceans under this change of conditions.* The Tertiary fresh-water species quickly appeared, partly by transmutation from the previous marine species and partly by transportation in various ways from other fresh-water lakes. But all this occurred in some places without the slightest break in the continuity of the strata.

The great change of climate and other physical conditions perhaps sufficiently explain the change in *invertebrate* species, but it is impossible to account for the somewhat sudden appearance of mammals in the lowest Tertiary, except by *migration* from other regions where they had existed in late Cretaceous times, having originated there by derivation in the usual way. That marsupials existed somewhere in Cretaceous times (though possibly not in America or Europe) there can be no doubt; for they lived, we know, in the preceding Jurassic and the following Tertiary, and they exist *now*. It is from these rather than from Cretaceous reptiles that Tertiary mammals were doubtless derived; and this derivation took place probably at a rapid rate in the latest Cretaceous or during the lost interval, in some unknown locality, whence they migrated into the Tertiary lake region of the United States during the interval. This migration came most probably from Northern Asia, for it must be remembered that the interval was a continental period, and therefore probably a period of broad land connections between Nearctic and Palæarctic regions. The complete examination of the uppermost Cretaceous of different portions of Asia will probably reveal the immediate progenitors of the early Tertiary mammals of Europe and America. This introduces us to a most important element of rapid local faunal change, especially in higher animals, namely, migrations. If we do not dwell longer now on this, it is only because we shall have to recur to it again.

(TO BE CONTINUED.)

*Arch. des Sciences, November, 1875, p. 284.

FLESH FOSSILIZATION AN IMPOSSIBILITY.

BY PROF. B. F. MUDGE, OF KANSAS.

The occasional exhibition of pretended fossil men, like the Cardiff Giant and the recent Colorado specimen, opens the practical question of fossilization. Those who patronize such exhibitions do not appear to know the fact that flesh, either human or animal, is never petrified or fossilized. In other words, flesh is composed of such soft, changeable substances that it decays too rapidly for petrifaction. When, then, a mass of stone is brought before the public as a petrified man, with the statement that the flesh on the hands and face has a natural appearance, it is not necessary for the geologist to visit and examine it in order to know that it is an imposition. Science has taught him that flesh is never changed to stone. In all the scientific collections of Europe or America there is not an ounce of fossil flesh. Could such a specimens be found it would command its weight in gold.

It is true, that rarely—but very rarely—human bodies have been changed to adipocere, and in that condition have remained for a considerable time without decay. But this is only a change to a rare form of fatty substances and is in no sense a petrifaction. It is still an animal substance, which will soon change its weight and character on being exposed to the atmosphere.

Mummies, either Egyptian or Peruvian, are cases where the decay of the firmer portions of the flesh is arrested, and the watery particles allowed to dry out, thus losing two-thirds of the weight.

But what is petrifaction? It is the gradual exchange of the organic particles of the vegetable or solid animal substances, for lime, silica, carbon, iron, or other inorganic, chemical ingredients. In rare instances the firmest cartilages of a few animals have been in this manner fossilized. But petrifaction takes place so slowly, and by such minute particles, that flesh invariably decays before the change takes place.

Where fossilization goes on thoroughly, and in the most perfect manner, the replacement of the particles occurs so carefully, slowly and minutely, that the original cell structure, however minute and delicate, remains, and is still seen under the microscope. Thus the cell form of the old Devonian pines, where all the vegetable matter is gone, still retains its fine markings, less than one-five-thousandth of an inch in size. Ehrenberg found 42,000,000,000 (forty-two trillions) of fossil infusoria in one cubic inch of Tripoli, each perfect in structure.

The writer has fossils from Osage County, Kansas, where the original matter is replaced by iron pyrites, shining like gold, where the primal form is in most excellent preservation. In some other specimens, from Western Kansas and Colorado, this replacement is by agate, carnelian and chalcedony, which will take the highest polish and yet allow the organic structure to be plainly visible.

Of the various substances which compose the fossil after petrifaction, lime is the most common; carbon and silica (quartz) are the next most common. Vegetables most commonly change to carbon in the transformation to silica. We have frequently seen wood in the Cretaceous deposits, where a portion of the fibre was still carbon, and other portions pure quartz, both showing the annual rings and cell structure.

THE RIVER BLUFFS.*

BY PROF. JOHN D. PARKER, OF KANSAS CITY.

Chief among influences moulding a people are those derived from Nature. Like odors distilled from flowers, or colors playing in sunbeams, the subtle powers of Nature elude analysis. But as the crystal lake mirrors the landscape which environs it, so Nature is reflected in any people. In the mountains of Greece we find the greatest æsthetical development of the Old World. Italy with its sunshine and flowers, its brilliant skies and out-door life, developed an indolent but happy people. The canton sprang up amidst the eternal mountains and Alpine glaciers of Switzerland. England, with its comparatively immense shore-line, its fogs distilled from the Gulf stream, and its pastoral lands, developed a strong but phlegmatic race. The New England hills naturally moulded a people possessing the highest and best traits in man. Muscular development was required to subdue Nature, intelligence evolved in developing and applying science to industry, culture was inwrought and polished manners ground out by the attrition of society, and art was engendered by the luxuries which Nature offers to those who hang over with delight and feast upon landscapes. During our civil strife, the love of liberty was found strongly intrenched in the mountainous districts of West Virginia, North Carolina and East Tennessee.

It is the purpose of this paper to inquire, What has Nature done for the higher development of the dwellers on the great central plains of the North American continent?

In wealth and variety of soil the great plains are justly celebrated. Nothing can exceed the depth and fertility of the alluvial deposits. The cereals of the temperate zone grow with almost spontaneity. The sacred phrase has its counterpart, a thousand cattle on a hill. With mineral resources Nature has stored her secret chambers. The offerings of grains and fruits and flowers are in profusion. But what keeps a people living among such luxuries from indolence and retrogradation?

Among Nature's opposing forces may be placed river bluffs, an American term applied to cliffs or high banks overhanging streams. The river bluffs constitute an important element in the physical features of the West. The Mississippi River and its numerous and powerful affluents nearly always flow between these bluffs, rising in places as massive walls, and sloping back sometimes for miles from the river on either side with decreasing undula-

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* Read before the Kansas Academy of Science, 1876.

tions, and melting away at last in the level prairie. Counting both banks, this system of rivers alone would give a single line of elevations meandering through the great plains something like twenty thousand miles in length, and rising at some points to a height above the river of five hundred feet.

The geology of the river bluffs unfolds itself on the following dynamic principles. In an open country like the prairies, rivers possess two elements—a channel and a flood-plain. During the winter season, and some months in summer, the stream is confined within the channel. But during freshets, and particularly the June freshet, which is swollen by mountain snow, the stream rises and spreads over the flood-plain. Now, should the interior of the continent be elevated say a hundred feet by internal forces, the coast-line remaining the same, the river would have a greater fall, quicker flow, and more eroding power. A new channel and a new flood-plain would be cut, both of less width, leaving the outer margins of the old flood-plain as an elevated terrace. And the walls of the original geological suture, or outer banks of the stream, would be left by the receding water to be elevated by such successive epochs into river bluffs. And the partings or lips of any suture in the original crust would be slightly turned up by escaping steam or gases, or outward pressure of the yielding mass beneath, leaving the bluff elevated above the surrounding prairie. Four such elevations have taken place since the rivers of the eastern portion of the continent began to flow, and three since the Mississippi began to pursue its course toward the Gulf. As the geological elevation has been greatest toward the interior and western portion of the continent, the eroding power of rivers has proportionally increased, causing the river bluffs to become more prominent as physical features of the country as we ascend the rivers, just, as we shall see, where they are needed.

The meteorology of the river bluffs is an important element to those dwelling on the great plains. People always living among hills crowned with forests do not realize the force or constancy of the winds in a level prairie country. At Lawrence, Kansas, for example (a place not exposed as much as many points farther west), the self-registering anemometer on the University building, situated on Mount Oread, furnishes the following record: During the year 1875 the wind traveled 145,316 miles, which gives a mean daily velocity of over 398 miles, and an hourly velocity of over 16 miles. These total winds, flowing uniformly over the whole year, would give the people of Lawrence a constant current of air between a fresh breeze and a strong wind. On January 8, 1875, at the same place, the wind attained a velocity of seventy-five miles an hour, a violent gale, only one remove from a hurricane.

The same general belts of wind, running east and west, prevailed around the globe. But the forest-crowned hills of New England and the Middle States drive these currents up into the higher regions of the atmosphere. Now the river bluffs are the natural wind-breaks of the great central plains, and without them the prairies would be a bleak, an almost uninhabitable plateau.

Many have observed that rain storms follow streams, without understanding the principles involved. Streams saturate the contiguous air, which again yields its moisture to a condensation, which does not reduce the dryer air lying outside at a distance from the river to the dew-point. In a similar manner, a super-saturated sponge will give forth moisture to a pressure under which a partially saturated sponge would not yield a drop. A cool current of air passing over the country would thus cause the condensation of vapor, or the ever-forming rain cloud, to appear to travel along river courses. And the greater precipitation of moisture along river courses has been one essential element in the growth of forests, frequently covering river bluffs to give them more force as wind-breaks.

The horticulture of the river bluffs is worthy a passing thought. The pursuits of any people determine to some extent their character. Horticulture is a scientific pursuit involving mind, and possessing elevating tendencies. Now the river bluffs are the natural home of the horticulturist. The condition of the soil and climate determine this pursuit almost to the exclusion of cereals. The apple, pear, plum, peach and apricot love the bluffs, and the small fruits flourish. Notably the grape finds its home among the bluffs. We see its rich purple clusters peeping out beneath leafy trellis bars up the sides of almost inaccessible heights. A horticultural people sandwiched in all through the great plains, and mingling freely with neighboring communities while discussing cognate topics, are not devoid of influence which tends to lift a people into higher forms of living. When the year comes to his prime and bears to our homes his rich stores, ripened with dew, sunshine and shower, we dream of Eden, the ideal of human earthly perfection.

The æsthetics of the river bluffs must not be neglected. The absence of this element is dangerous to any people. When painters cease to study Nature's habitudes, and galleries of art are neglected, when poets forget to draw from her their inspiration and repeat her voices, decay falls on a people. In the great plains almost the only elevations are found along the rivers. From these heights the prairies with their green carpets richly ornamented with flowers unfold before us. Nothing compares to a prairie scene except the mighty ocean. The blue vault hangs over us more cerulean than in Eastern climes, the river winds its silver thread between the bluffs until it seems to be broken, and the undulating prairie rolls all around us like the ocean. With such scenes ever before a people can there be decay in poetry, painting or sculpture?

The home life of the river bluffs is an essential element. Nearly all our Western cities and smaller towns, containing quite a proportion of the population, are found along the rivers nestled in the bluffs. The luxury of hills is thus brought to our very doors. No one is in condition to enjoy this luxury until deprived of it. When hills are piled on hills, as in some of the States, there is too much of a good thing. Desserts of rich food eaten daintily become a luxury. River bluffs are the desserts of our broad prairies, with which Nature has stored her ample board. The prairies satisfy our physical wants; the bluffs feast our souls. The prairies pour in their ample products until all our storehouses are filled beyond measure. The bluffs lift up our homes and spread the board with ambrosial food. Lifted above the earth we live nearer the gods. We drink in the royal landscape around us, of which poets and painters may only dream. The luxury of a prairie home nestled in the bluffs cannot be portrayed.

At the mouth of the Kansas River, Nature evidently planned a city. From this point the railway system naturally radiates. But the frowning bluffs seem to forbid it. Gradually the bluffs melt away to fill the deep ravines. Easily-graded streets leave terraces on either side, to be the sites of comfortable homes, while the crests, with finer views, are crowned with mansions. We love homes lifted a little above the busy streets on terraced heights, surrounded with fountains and trees, fruits and flowers. Such homes are being built all along the Father of Waters—rural retreats of luxury, taste and culture.

To the great central plains of North America, the river bluffs are Nature's richest gift. For ages Nature was slowly moulding them, and setting them as watch-towers through all the land. They shield man from the elements, which, unobstructed, would desolate his home; they furnish the conditions of a higher rural life; they disclose rich minerals, which Nature has stored in her secret chambers; they reveal the beauties of Nature hidden in landscapes; they furnish sites for homes of comfort and luxury; they tend to lift a people, in a word, out of a dead level, giving the power of elevation from which flows intelligence, culture and true refinement; they open a fountain of living waters to slake the thirst of coming millions. The gods dwelt in Mount Olympus, we are told, in the olden times; so here diviner forms seem to descend to dispense to men their richest favors. Here are the lines of light that shall grow brighter and broader, we trust, until the whole land shall be enlightened and filled with true knowledge. Here shall the graces descend into human habitations, filled with sunshine and gladness, as long as rivers flow murmuring to the sea.

GEOLOGY OF THE WEST.

BY J. VAN CLEVE PHILLIPS.

In boring the artesian well at the Insane Asylum, St. Louis, the auger penetrated 3,800 feet, going through 200 feet of coal measures, 500 feet of sub-carboniferous limestone, 1,000 feet of Devonian, and 2,000 feet of upper and lower silurian, and in the bottom cut a ferruginous sandstone, supposed to be of the Potsdam age.

This sandstone carries the fossil of a marine animal known as the trilobite, and establishes the fact that at 3,500 feet in depth below the present level of the Mississippi river and the pavements walked by the busy population of St. Louis, once rolled the waves of the silurian ocean.

We will suppose this auger hole is a shaft 6 by 10 feet square from the surface to the bottom of the hole, and that we have the privilege of going down and examining the strata in its sides as they would appear from the records shown by the borings as the auger penetrated the strata.

First we pass 20 feet of alluvial brick clay, then 40 feet of pipe clay, shaley limestone and fire clay, and at 60 feet deep we find a three foot vein of coal; at 200 feet we reach the upper Archimedes limestone, the same stratum that is exposed at the top of the deep quarry on Tayon avenue, and which contains fossil fish; this is also the same age of rock as the Grafton quarry. Below this is the St. Louis limestone, and next another floor of Keokuk or archimedes limestone, a rock filled with fossils. At 1,200 feet we reach the great salt and oil floors of the Mississippi basin. This stratum comes to-day 30 miles below on the I. M. and S. R. R., and west 30 miles on the M.P.R.R., and from a quarry south of the city that furnished the rock to build the basement of the Four Courts; and as that rock weathers, its black, mottled color is due to the bitumen which the heat of summer has brought to its surface. Chicago is built on this geological horizon, and strata in quarries west of that city are filled with bitumen and petroleum. If space would admit, we might trace this floor throughout the length and breadth of the great basin of the Mississippi, and show where it rises to-day; and has again gone down 4,000 and 5,000 feet under the coal measures of the grand prairies of Illinois and Kansas, and is formed in a great basin in Venango county, Penn., and this again subdivided in lesser basins, and where the economic laws had stored the rich floors of petroleum that have proven such a source of national wealth. But we must go downward. At 2,000 feet we have reached the Niagara group of the upper silurian series, a rock rich in fossils, and of the same age as that over which the great cataract pours its thundering falls. This rock also forms the table lands of Iowa, west of Dubuque, and is the formation of the mammillary outlying mountains that make such a conspicuous feature in the topography of the upper Mississippi lead fields, also forms the mound system of the great lead and zinc fields of Central Missouri. Below this we reach the "Trenton limestone," a member of the silurian system, and same age of rock as found shelving out at low water mark on the Mississippi opposite Dubuque, Iowa, and where the weathering of the slabs has exposed in an embossed form the tribe of the *orthosceratites.* These fossils are there seen six and ten feet in length, and with their enameled scales and bucklers were the mailed warriors of the silurian seas. Below we find the lower floors of the lower silurian, chert-beds, hornstone and coralline limestone, the same age of rocks as that which abuts against the Iron Mountain on its west side, and is the great lead, zinc, copper and iron-bearing rock of South-east Missouri. In passing the Archimedes floor in the subcarboniferous system, we were in the horizon of strata that carries the great lead and zinc veins of South-west Missouri.

And in passing the Niagara and Trenton groups we were in the horizon of the blue shales, cap-rock, upper and lower galena and blue limestone of the upper Mississippi lead field. On reaching the bottom of our shaft we find a coarse, brown, ferruginous sandstone; and we might in the imagination follow this floor to where it rises to-day around the Iron Mountains, 100 miles south of the city, and where it dips under the great coal basins of Central Illinois and Kansas, and comes to-day on the shores of Lake Pepin, Lake Superior, and covering large areas in Northern Wisconsin, being the stratum that bears the great pine flora of that State, and to where it extends out from the "great basin," in a long finger through central New York.

We have now a general idea of the underground system under this city, and if we go back in the imagination to the time when the strata of the upper, middle and lower coal series had been laid down, and the inauguration of the river systems commenced, we shall find that the coal vein of St. Louis County coal basin and the Illinois coal basin in that era lay in solid strata where the Mississippi River now flows—that the strata were elevated along the lines now followed by the river, and 300 feet of coal measures and St. Louis limestone has been abraded, and a coal vein for ten miles wide has been cut away to form the valley through which the river now flows opposite the city.

The science of geology is based on the idea that like produces like; that the great is in the little, and *vice versa*, and that all the phenomena of the earth's surface, and its strata, and vein system have been produced by the constancy of action of natural economic laws, and that these causes are now in action. And where are we to look for the causes now in action that laid down upon the floor of an ocean the sedimentary matter to form all the strata, from the sandstone in the bottom of this artesian well to the upper coal series, say 6,000 feet vertical of strata? We shall see.

The Mississippi River carries out millions of tons of sedimentary matter daily from the washings of the banks of the hundred tributaries of the Gulf of Mexico; this sediment is there taken up by the Gulf Stream, and carried North and spread over the floor of the Atlantic, when it settles in comparatively still water under what is known as the Saragossa Sea; and if we follow up the genealogical thread or heraldry of this river system, we shall see that this process of spreading detrital matter over the ocean's floor has been going on since the river system in the "great basin" was inaugurated, and the wearing down of the valleys of the Ohio, Tennessee, Rock River, the Missouri, Arkansas, and a hundred other branches, were carried forward.

At Dubuque, Iowa, 600 feet-vertical strata have been cut away; at Pittsburg, 400; at Cincinnati, 100; from the head of the Ohio to its mouth from 100 to 500 feet. The same of the Missouri, Arkansas, St. Peters, Cumberland, White, and hundreds of other branches. Enough sedimentary matter has gone out of the mouth of the Mississippi River from the washing down of the valleys of these streams and forming of the topography of the great basin of the Mississippi River to have filled up the Gulf of Mexico and then formed an island 1,000 feet high above its present level; and this sedimentary matter has been taken up by the Gulf Stream and carried out and spread over the floor of the Atlantic Ocean, where, in comparatively still water, it has settled and formed stratified rocks; and here we now see the causes in action that at one time prevailed, and which laid down upon the ocean's floor the sedimentary matter to form the Potsdam sandstone, now bored in the bottom of this artesian well, and all the strata above to 6,000 feet were afterward piled on the floors of subsequent seas. The history or chronology of these strata is written in the fossils, salt and oil flows and coal plants which grew in successive floras, and were laid down and are now carbonized in mineral fuel in these great continental coal basins. The Iron Mountain lead, zinc and copper veins belong to a later era, a comparatively recent geological epoch, as there was no necessity for the existence of these ores until men had come to have dominion on the earth and to be conditioned to utilize these metals.

When standing on the floor of Potsdam sandstone, we may safely say that in this early day of the chronology of the strata navies did not ride upon the bosom of the deep to founder and go down with all their armature of war, as would be found if Atlantic's floor should be dried land.

The fossils tell us that the nautilus and ammonite were the only sails then seen; that these early voyagers its compeer then on the waves of this silurian sea then did hail.—*St. Louis Republican.*

A FOURTH OIL ROCK.

The existence of a regular fourth sand, south of Bradford, has been conclusively demonstrated by the tests made on the Big Shanty well, located on the Dent track. This well, it will be remembered, was drilled several months ago to a depth of 1,598 feet, striking the third sand at 1,545 feet. The sand was about forty feet thick, and the well has been producing five barrels a day ever since, up to a few weeks ago, when the company decided to drill the well deeper. This was done, and at a depth of 1,645 feet a fourth sand was found, twelve feet in thickness and of a good quality. Pumping has already been started and the supply will be improved.

ASTRONOMY.

LEVERRIER AND HIS WORK.

In the death of Leverrier the world loses its most eminent astronomer; but unlike many disciples of science, he bequeaths to posterity not unfinished work which none but a master mind equal to his own could complete, but the record of undertakings carried to successful endings, and together aggregating the noblest astronomical achievement ever accomplished.

Urbain Jean Joseph Leverrier was born at St. Lo, in the old Department of Normandy, France, on March 11, 1811. He was a chosen student and obtained honors in the Polytechnic School, which entitled him to a choice of employment in any of the select branches of the public service he might desire. Choosing the position of engineer attached to the administration of the government tobacco monopoly, in order that he might possess the necessary facilities for the continuation of his studies, his attention was first directed to chemical experimentation, and in 1837 he published his first original investigations, announcing a new combination of phosphorus and oxygen. His preference, however, was for mathematics, and in 1839 he began the colossal astronomical task, the termination of which he himself announced to the French Academy of Sciences on December 21, 1874.

In order to reach a just estimate of this vast work, it is necessary to recall the fact that in the solar system the mass of the sun is so great that that luminary is capable of swaying the motion of all the planets without being himself disturbed. Although the planets exert an attractive power on the sun, still if their joint attraction were exercised upon him in a straight line, he would not be disturbed by a space equal to his own radius. So vast then is the controlling power of the sun that even the greatest disturbance in the entire system (that resulting from the mutual attraction of Jupiter and Saturn) is inconsiderably small in comparison. But the fact still remains that the planets do disturb each other in varying degrees, and the more massive the planet the greater its influence upon its neighbors. Consequently and conversely, if we know how much one planet disturbs another, we have a means of determining the mass of the influencing body.

This determination was the object of Leverrier's inquiry, and he set to work to examine into the motions of the seven planets known at the period when his labors began. It is scarcely possible for any one, not conversant with the delicate and intricate toil of the astronomer, to appreciate the multitudinous perturbing causes which in such an investigation it becomes necessary to take into account. Some idea may, however, be gained from the fact that in determining the earth's motion around the sun—but one part of his subject—Leverrier reviewed and discussed nine thousand distinct observations. "Our conclusion is," he says, referring to these, "that the observations of the sun leave much to be desired, on account of systematic errors affecting them; and there is no discordance between theory and observation which cannot be attributed to errors in observing."

Still, from these imperfect data, he estimated the sun's apparent monthly displacements and deduced therefrom an estimate of the distance of the sun, showing that the generally accepted figures were too large by between three and four millions of miles.

Meanwhile, by a most careful analysis of all available observations of Uranus, Leverrier had satisfied himself that that planet was undergoing disturbance by some unknown body. He was in the position, to borrow Prof. Proctor's illustration, of an observer who, traveling (say) along a canal, should observe "that certain waves, which had long been of a particular size, began to grow larger. Suppose that, struck by this, he instituted a careful series of measurements of their size, and at last satisfied himself that they had increased. . . If, however, while he had satisfied himself by his wave measurement that the waves had really increased in size, he had also satisfied himself that during his observations the increase had reached its full extent, and had even begun to give place to a slow decrease, tending to restore the original size of the waves, he would manifestly have here an indication which might serve to tell him of the very spot where the disturbance had taken place." Something of this kind had happened in the case of Neptune; and when Leverrier's analysis of the motion of Uranus was finished, it was seen that the displacement had reached its maximum and was beginning slowly to decrease. In order to produce these perceptible effects—and many years were occupied in their production, for it is now known that Uranus only completes his circuit in 84 years, while Neptune requires 164 years—Leverrier assumed that another planet must exist; and from the observed perturbations of Uranus, he calculated the orbit and position of the unknown world. On the 1st of January, 1847, six months after Leverrier had completed the calculations, the planet was found within two degrees of where Leverrier predicted it would appear on that date.

We pass over the long discussion among astronomers as to whether Leverrier or the English observer Adams was the true discoverer of Neptune; both overcame enormous mathematical difficulties, but whether Adams first conceived the existence of Neptune or not, Leverrier certainly earliest made known the discovery to the world.

The quite recent discovery of an inter-Mercurial planet, which afterwards proved to be a sun-spot, brought M. Leverrier's investigations into the motions of Mercury prominently forward. He long ago determined that the movements of Mercury as observed, did not accord with those calculated. "The result," he says, "naturally filled us with inquietude. . . Long years passed, and it was only in 1859 that we succeeded in unraveling the cause of the peculiarities recognized." There exists, he states, in the neighborhood of Mercury, doubtless between the planet and the sun, some matter as yet undiscovered; but whether it consists of one or more small planets or other minute asteroids, or even of cosmical dust, he does not positively assert. The present opinion is that the meteoric and cometic matter existing in the sun's neighborhood in enormous quantities, produces the perturbations of Mercury; but Leverrier clung to the belief in Vulcan, and manifested the most intense interest in every alleged discovery of that planet. When Lescerbault believed that he had found the inter-Mercurial world, Leverrier was one of the first to abruptly present himself and to demand how the discoverer had dared "to commit the grave offence of keeping your observation secret for nine months. I warn you," he continued, "that I have come here with the intention of doing justice to your pretensions;" and then he examined Lescerbault's primitive apparatus, cross-questioned him sharply, and finally departed, overwhelming the supposed discovery with his congratulations. How Liais upset his discovery by showing the imaginary Vulcan to be a sun-spot is well known; and a repetition of similar experience recently is said to have left the great astronomer disappoined and unhappy.

Leverrier's examination of the motion of Venus resulted in tables of wonderful accuracy. He study of the motions of Mars revealed the influence on that planet of the asteroid zone. Summing up his work, Prof. Proctor says: "Beyond question he has deduced from the observed motions of the planets all that at present can be deduced as to the masses of the different known and unknown parts of that complex system which occupies the space ruled over by the sun."

In 1853, M. Leverrier became Director of the Observatory in Paris, which post he occupied until 1870, when he resigned, but in 1872 he resumed his duties, which he has since continued. He took the greatest interest in the large telescope recently elected at the observatory. "It comes none too soon," he replied coldly, when congratulated on its completion; and he at once set to work, hoping by its aid to settle the question of the inter-Mercurial planet. His labors were severe, his rest broken. The task was too much for a man sixty-six years of age, whose life had been one of incessant toil, and he sank under it. His death occurred on September 23.—*Scientific American.*

AMATEUR OBSERVATIONS OF THE NOVEMBER METEORS.

On the 13th and 14th days of November, the earth makes its annual passage through the second of the great meteor belts which intersect its orbit. The thickness of this belt at its thickest part is estimated by Prof. Proctor at some 100,000 miles, and it is supposed that the denser portion of the system or "gem of the meteor ring" contains at least one hundred thousand million meteors. These however, Herschel has calculated to be extremely small, rarely exceeding a few ounces in weight. It has further been determined that the November meteors mostly radiate from the constellation *Leo*, and the aphelion of their orbit is somewhat beyond the planet Uranus.

Late investigations have pointed to the identity of the orbit of some of the comets with the orbits of different groups of meteors. The path of the meteors, for example, which are usually seen from August 9 to 14, coincides with that of the bright comet of 1862, and both Peters and Schiparelli independently discovered some time ago that Tempel's comet of 1866—a body visible only with the telescope—has elements which may be regarded as absolutely identical with those of the November belt. It is not definitely known however, what connection exists between the comets and the meteors, though it appears that the latter have paths as eccentric as those of the cometic orbits, and hence it is deduced that the earth encounters no less than 56 meteor systems, thus affording proof that the total number of these systems in the universe must be estimated by billions.

It will readily be seen that a knowledge of the elements of the paths described by the meteors is of considerable astronomical importance. While, as already stated, the general direction or radiation is from the constellation *Leo*, it has been observed that often on the same night many distinct centers of radiation may be traced. It is by the determination of these centers that the elements above referred to may be calculated. Then by comparing the results with the elements of the orbits of known comets, it becomes possible to discover which comets, by rupture, according to one theory, probably gave rise to the various groups of shooting stars. Hence observations made with the naked eye, which fix the exact point in the heavens whence the meteors appear to radiate, may prove of value.

It is necessary first to note the region of the heavens whence the meteors appear, and then specially to observe those bodies which seem to have the shortest trajectories. These will, of course, be the ones nearest the center of radiation, and in this way the location of the latter can be quite accurately determined. Look also for a pale light something similar to the aurora, which is often present about the radiating point. It is also useful to note the color and brilliancy of the meteors. The latter may be estimated by comparison with Jupiter and Venus, the brilliancy of these planets being taken as the maximum. If the meteors leave a trail behind them, note the fact, and also observe how long the trail remains visible after the star disappears, also whether it has any backward motion. A field glass may be advantageously employed to recognize any special peculiarities of the trail. These observations, if carefully made, will be accepted at any astronomical observatory. Meteors also appear from the 27th to the 29th of November, and from the 6th to 13th of December, but not in such numbers as upon the above mentioned dates.—*Scientific American.*

THE SATELLITES OF MARS.—Since our article on this subject was in type, we have received the following note from Dr. Robert Reyburn, of Washington, D. C.: "In the recent accounts of the discovery of the satellites of Mars, we have not seen any reference to the curious fact of the announcement of their existence by Dean Swift in his celebrated satire, 'A Voyage to Laputa,' published in 1726. It may be found in the third chapter of that work, and reads as follows: 'They have likewise discovered two lesser stars or satellites which revolve about Mars, whereof the innermost is distant from the primary planet exactly three of his diameters, and the outermost five; the former revolves in the space of ten hours, and the latter in twenty-one and a half, so that the squares of their periodical times are very near in the same proportion with the cubes of their distance from the center of Mars, which evidently shows them to be governed by the same law of gravitation that influences the other heavenly bodies.'

"This was expressly written to cast ridicule upon the astronomers of his day, and now about one hundred and fifty years afterwards it becomes numbered among the established facts of science."—*Boston Journal of Chemistry.*

SOLAR SYSTEMS OTHER THAN OUR OWN.

We know a great number of stars which are accompanied by smaller stars, moving around them like the earth around the sun. These systems, which are now numbered by hundreds, have been so carefully observed that we have been able to calculate the orbits and periods of the planets, brilliant or opaque, which compose them.

It is, then, no longer on mere hypothesis that we can speak of solar systems other than our own, but with certainty, since we already know a great number, of every order and of every nature. Single stars should be considered as suns anologaus to our own, surrounded by planetary worlds. Double stars, of which the second star is quite small, should be placed in the same class, for this second star may be an opaque planet reflecting only the light of the large one, or a planet still giving out heat and light. Double stars of which the two components give the same brightness are combinations of two suns around each of which may gravitate planets invisible from this distance; these are worlds absolutely different from those of our system, for they are lighted up by two suns, sometimes simultaneous, sometimes successive, of different magnitudes, according to the distances of these planets from each of them; and they have double years, of which the winter is warmed by a supplementary sun, and double days of which the nights are illuminated, not only by moons of different colors, but also by a new sun, a sun of night.

Those brilliant points which sparkle in the midnight sky, and which have, during so many ages, remained as mysteries in the imagination of our fathers, are therefore veritable suns, immense and mighty, governing, in the parts of space lighted by their splendor, systems different from that of which we form a part. The sky is no longer a gloomy desert; its ancient solitudes have become regions peopled like those in which the earth is located; obscurity, silence, death, which reigned in these far-off distances, have given place to light, to motion, to life; thousands and millions of suns pour in vast waves into space the energy, the heat, and the diverse undulations, which emanate from their fires. All these movements follow each other, interfere, contend, or harmonize, in the maintenance and incessant development of universal life.—Camille Flammarion, in *Popular Science Monthly* for November.

Photography Applied to Astronomy.—M. Cornu has devised an improved system of astronomical photography, the peculiarity of this method consisting in the fact that it does not require any special instrument, any telescope, and may at once be adopted for photographical observation by means of a purely mechanical arrangement, which does not at all affect the optical qualities of the instrument; the two lenses which compose the objective have merely to be separated to an extent depending on the nature of the glasses, but rarely exceeding one and a half per cent. of the focal distance. This operation shortens the distance about six to eight per cent. Theory and experience prove that the original achromatism of the visible rays is transformed into achromatism of the chemical rays, which is necessary to the perfection of photographic images. Direct and precise measurement has shown that this slight separation of the glasses does not cause any aberration in the images, which, of course, is an essential.

This method, it is stated, has succeeded perfectly at the Paris observatory, with the large equatorial, the objective of which is about 15 inches in aperture and about 29 feet in focal distance. By a very simple arrangement the glasses can be separated, and the instrument may be employed for optical as well as photographic observations. The photographic adjustment does not present any inconvenience in the observation of faint stars, M. Cornu stating that he easily observed Uranus and at least one of his satellites without re-establishing optical achromatism. At the principal focus of this instrument are obtained direct photographic images of the sun and of the moon, measuring nearly 3.42 inches in diameter—images which might be easily magnified by means of the eye-piece so as to give negatives of more than 39 inches in diameter.

A New Instrument for Science.—There is now in operation in the laboratory of Central University, Richmond, Ky., says the Louisville *Courier-Journal*, an interesting apparatus that records in a beautiful manner the motion of the earth in its hourly progress through space. It is the invention of Prof. T. W. Tobin. The principle upon which the instrument is formed is, that a delicately constructed pendulum will continue to oscillate in the same direction as started, and preserving that plane, mark the movement of the earth beneath it. The principle was demonstrated by Foucault, a a philosopher, in 1851, was verified in Boston at the Bunker Hill monument, and lastly again at Yale College. The apparatus hitherto employed has been cumbersome, and the results obtained somewhat vague. The experiments, nevertheless, bear historical interest, and are related in modern text-books on physics. It has devolved on Kentucky to furnish the scientific world with a finished and mathematical demonstration of this beautiful phenomenon, together with the apparatus for producing the result so as to be proved in a school-room or laboratory. The instrument is about six feet high, consisting of an iron tripod and delicate pendulum. There is an index attached to the upper portion of the pendulum, and when the pendulum is started this is perfectly still. In six minutes the earth's motion becomes apparent, and the needle shows about one degree of deviation. In one hour the movement is so marked that the distance traversed by the earth may be estimated from its data. The pendulum is of such delicate construction that it will remain in motion for twelve hours, and yet may be retarded or even stopped by blowing upon it.

MEDICINE.

CONSUMPTION A DISEASE OF IN-DOOR LIFE.

Among the natives of Senegambia pulmonary a ections are not only nearly but absolutely unknown; yet a single year passed in the over-crowded man-pens and steerage-hells of the slave-trader often sufficed to develop the disease in that most virulent form known as galloping consumption; and the brutal planters of the Spanish Antilles made a rule of never buying an imported negro before they had "tested his wind," i. e., trotted him up-hill and watched his respirations. If he proved to be "a roarer," as turfmen term it, they knew that the dungeon had done its work and discounted his value accordingly. "If a perfectly sound man is imprisoned for life," says Baron d'Arblay, the Belgian philanthropist, "his lungs, as a rule, will first show symptoms of disease, and shorten his misery by a hectic decline, unless he should commit suicide."

Our home statistics show that the percentage of deaths by consumption in each state bears an exact proportion to the greater or smaller number of inhabitants who follow in-door occupations, and is highest in the factory districts of New England and the crowded cities of our central States. In Great Britain the rate increases with the latitude, and attains its maximum height in Glasgow, where, as Sir Charles Brodie remarks, windows are opened only one day for every two in Birmingham, and every three and a half in London; but going farther north the percentage suddenly sinks from twenty-three to eleven, and even to six, if we cross the fifty-seventh parallel, which marks the boundary between the manufacturing counties of Central Scotland and the pastoral regions of the north.

It is distressingly probable, then to say the least, that consumption, that most fearful scourge of the human race, is not a "mysterious dispensation of Providence," nor a "product of our outrageous climate," but the direct consequence of an outrageous violation of the physical laws of God.—Dr. Felix L. Oswald, *in Popular Science Monthly for November.*

Chlorate of Potash in Diphtheria.—The following is a summary of an interesting article by Dr. A. Seeligmüller, of Halle, Prussia, contributed to the *London Medical Times and Gazette:*

(1.) The chlorate of potash administered in a saturated solution (five per cent.) has a specific effect on diphtheria.

(2.) It must be given in a solution of ten grammes in two hundred grains of distilled water, without adding any syrup or any other substance to ameliorate the taste.

(3.) This solution is to be ordered to infants under three years at half a spoonful, to older ones at a whole spoonful, every two hours (if the malady is very grave, every hour); at first day and night without interuption.

(4.) This internal medication alone will suffice in all cases.

(5.) The saturated solution of chlorate of potash exercises (*a*) a topical action and (*b*) a general one on the diphtheritic process: (*a*) a topical one, as a mild cautery, and by separating the diphtheritic pseudo-membranes from their basement membranes; (*b*) a general one, supplying the oxygen withdrawn from the blood corpuscles by bacteria and destroying these organisms.

(6.) Caution is required lest the saturated solution may act dangeruosly on heart or digestion. When such symptoms occur, the administration must be suspended.—*Boston Journal of Chemistry.*

Citric Acid in Diphtheria.—Dr. Caspari states in a German medical journal that he has treated successfully more than forty cases of diphtheria by using locally (with the spray and brush) slightly diluted citric acid. Several of these cases had resisted treatment by salicylic and carbolic acid. Appropriate constitutional treatment was, of course, combined with the local.—*Boston Journal of Chemistry.*

For Rheumatism.—A physician in New York city, long a patron of the *Journal*, sends us the following formula:

℞ Iodide of potassium........................ ʒ iss.
Tinct. Colchicum,........................
Syrup rhei........................ āā ℥ i.
Water........................ ℥ ss.
M. Sig. Teaspoonful every three hours.

Anodyne Enema.—Chloroform one to two grammes (a quarter to half a drachm), powdered gum acacia eight grammes, the yolk of one egg, and water 125 grammes. This is Dr. Aran's *lavement calmant*, intended to be used whenever pain has to be subdued, and especially in hepatic or nephritic colic, cystitis, etc. Camomile tea or decoction of poppy-heads may be used in place of the water.

ANATOMY AND PHYSIOLOGY.

ON THE LAWS OF DIGITAL REDUCTION.

BY JOHN A. RYDER.

At a recent meeting of the Philadelphia Academy I called attention to several facts bearing upon an explanation of digital reduction. It was suggested that the fact of the number of toes being least wherever mechanical strains were greatest and impacts most frequent and most severe might be regarded as an effect of such increased intensity of strains. To make this conclusion appear valid it was only necessary to refer to the foot-structure of the different orders of the class of mammals.

It may be observed that among the primates the only creature having any one toe greatly augmented in size and strength is man; here it is the great one, or the first of anatomists. Its whole structure, especially the articulation with the carpus, calls to mind the condition of things found to exist in the groups which have undergone the most modification in the structure of the feet, namely, the ungulates or hoofed animals, kangaroos, and jumping mice. The calibre of its distal elements is greatly increased, while the ento-cuneiform and navicular are greatly flattened or modified in the same way as the magnum and unciform of the manus and the middle and ecto-cuneiforms of the pes are in many ungulates, or as is the cuboid in the kangaroos.

In ungulates the third and fourth toes become functional, the second and fifth either disappearing or else assuming the office of lateral supports. In the jumping mice (*Dipodidæ*) the second, third and fourth of the hind feet are the functional ones; in one species three toes are all that remain; in another with four the fifth, a rudimentary one, does not reach the earth; and in another species with five the first and fifth toes are rudimentary. In these three animals, then, of one family and only generically separable by the difference in the number of toes, we have a case in living animals resembling the "demonstrative evidence" of Prof. Huxley drawn from fossil horses' toes, which so far as the necessity for time is concerned shows that creatures of almost identically the same habits and structure may be cotemporaneous, yet differing widely in the number and length of the hind toes. It indicates, it seems to us, that toe modification goes on at greatly varying rates. In the kangaroos the fourth and fifth toes of the hind foot are most strongly developed, while the second and third are atrophied and used only to cleanse the fur. It may be noted here, also, that the toes of the fore foot of the kangaroo remain entirely unmodified, and much the same as is the case in the jumping mice, for the reason that the strains are more equally distributed.

The *Chrysochloris* amongst moles offers an instance where the digital reduction has taken place in the anterior extremity, where also the mechanical strains are most frequent and severe. The same fact is observed in *Cyclothurus*, a little South American arboreal ant-eater, where but two functional toes remain upon the fore foot. In the great ant-bear (*Myrmecophaga*), the third digit of the manus is the strongest, the others evidently undergoing reduction, while the former is being constantly augmented by the strains to which it is subjected in obtaining insect prey.

The sloths of both recent and extinct groups furnish an instance where the number of toes has been reduced from the typical number five to as few as two in one pair of extremities in the living *Cholœpus*. The digits also in recent species are of about equal length, which cannot be said of the extinct terrestrial species, where in some cases (*Mylodon* and *Megalonyx*) considerable inequality existed. The equality in existing species is no doubt due to the equality of tractile strains upon each one of the digits, owing to the peculiar method of climbing and hanging to the limbs of trees by the great hook-like claws.

The frequent reduction in the number of toes in the foot before it commences in the hand is seen in the carniverous groups *Felidæ* (cats) and *Canidæ* (dogs), in odd-toed angulates, in the swift-foot terrestrial *Rodentia*, and universally amongst such animals as perform locomotion entirely by leaping with the hind feet, as the kangaroos and jumping mice. Upon this point it may be observed that these creatures all more or less decidedly leap, or else pitch the body through space in running, mainly by means of the hind limbs. The effect of this unequal distribution of strains has shown itself in the hypertrophy of certain digits and their consequent specialization at the expense of the atrophy of the others. The direction in which growth force is manifested is here determined, as it is determined in all kinds of work or exercise, by the increased development of parts most exercised, and shows that the claims of a certain surgeon, who is said to have been able to tell the occupation of tradesmen by inspecting the development of the muscles upon the body, are not without foundation. Two cases of this kind have fallen under my own observation, one in the person of a carpenter and another in that of a blacksmith.

It may be well to note in this place that man, the only *primate* whose feet serve exclusively for purposes of locomotion, belongs to the foregoing class. The outer toes in man are weaker, shorter and less developed than in any of the higher apes, and what may eventually be the fate of these outer toes, if, as many do, he keeps on wearing shoes that a savage would not wear for a single hour, combined with the structure now admirably conditioning a gradual reduction, only our descendants will be able to determine a thousand years hence.

The lines of bones through which strains have been directed are in some way determined by the uses which the feet serve in the life of the animal and its ancestral series. This is supported by the fact that where the strains to be overcome are equally distributed amongst all the digits there is rarely any specialization of toes. In aquatic, marine, and arboreal animals the distribution of strains is comparatively equal, and I now call to mind but a very few exceptions to this rule, which is but slightly affected by even these. One case is the *Cyclothurus*, where, however, the hind foot and tail are modified into grasping organs, leaving the great pair of claws in front for the purpose of tearing up the bark and getting into crevices in searching for insects. The *Dendrolagus*, or tree kangaroo, is another instance, but here the descent from the terrestrial kangaroos is too obvious to require discussion. In studying the fossil kangaroos Professor Owen noticed that the fur-claws were not as rudimentary as in the living species, showing that at one time there was a more uniform distribution of strains than now.

Among fossorial animals it is usual to find the claws and toes well developed upon the fore limbs; this is so in the moles, armadillos, recent and fossil, and in the *Geomyidæ*, or gophers, where the distribution of strains is very unequal in respect to the fore and hind pairs of limbs. So, too, in the group in which man has been included, where the strains are greatest upon the hind pair, as in animal that run rapidly or are capable of making great leaps, like dogs, cats, rabbits, tapirs, cavies, or guinea pigs.

It seems to us the most convincing proof of the doctrine of descent to find man an instance of the same kind of specialization determined by the manner of the distribution of strains as is so often found among the lower groups, such as the horses, sloths, jumping mice, and even-toed ungulates. We would not put him in respect to foot-structure among the true plantigrades, for unlike them the elements of the digits are not uniformly of the same strength and calibre. He might be somewhat clumsily called an inequidigitate plantigrade.

Now as to the osteological side of the question: in man the bones through which the line of greatest mechanical strain passes are the first digit, entocuneiform, navicular, calcaneum, and astragalus. In the horse this line passes through the third digit, external cuneiform, navicular, astragalus, and calcaneum in the hind foot; through the third digit, magnum, scaphoid, and lunar in the fore foot. In the kangaroo, through the fifth, but mainly through the fourth digit, the cuboid, calcaneum, and astragalus in the hind foot. It will be noticed also that in the highest member of the highest group it is the first digit that is specialized; in the intermediate groups that the intermediate digits are specialized; that next to the very lowest group it is the fourth digit; and, further, that there are corresponding chains of specialized bones which receive and distribute the strains.*

The following summary and conclusions are offered:

1. That the mechanical force used in locomotion duirng the struggle for existence has determined the digits which are now performing the pedal function in such groups as have undergone digital reduction.

* It may be as well to note that birds belong in the catagory of types which have undergone digital reduction. The ostrich, for obvious reasons, is the extreme. Among reptiles, turtles and dinosaurs may be included, both of which stand near the birds in the system.

2. That where the distribution of mechanical strains has been alike upon all the digits of the manus or pes, or both, they have remained in a state of approximate uniformity of development.

3. It is held that these views are Lamarkian and not Darwinian, that is, that they more especially take cognizance of mechanical forces as mutating factors in evolution, in accordance with the doctrine of the correlation of forces.—*The American Naturalist.*

THE BRAINS OF CRIMINALS.

In a recent issue we published a very interesting letter from our Vienna correspondent, in which a brief summary was given of Prof. Benedict's researches on the brains and skulls of criminals. The subject is an important one, both from a physiological and a psychological point of view, and it is to be hoped that more extended and more precise inquiries will be made upon it, for the results which Dr. Benedict has obtained, though very important, are not sufficiently numerous to warrant any large induction. Up to the present time Dr. Benedict has examined the brains of sixteen criminals, all of which, on comparison with the healthy brain, he finds to be abnormal. Not only has he found that these brains deviated from the normal type, and approach toward that of lower animals, but he has been able to classify them, and with them the skulls in which they are contained, in three categories. These consist in (1) absence of symmetry between the two halves of the brain; (2) an excessive obliquity of the interior part of the brain or skull—in fact a continuation upward of what we term a sloping forehead; (3) a distinct lessening of the posterior part of the skull in its diameter, and with it a diminution in size of the posterior cerebral lobes, so that, as in the lower animals, they are not large enough to hide the cerebellum.

In all these peculiarities the criminal's brain and skull are distinctly of a lower type than those of normal men, and the interesting question arises, how far are the evil acts of the criminal to be attributed to this retrograde development. Dr. Watts can pardon the vicious propensities of "bears and lions," on the ground that "God had made them so." If he had foreseen these new inquiries he might have felt less hopeful when he bade his readers not to "let their angry passions rise." The result of Dr. Benedict's researches, if confirmed by further examinations, will do much to shake many beliefs now firmly fixed.—*London Examiner.*

SCIENTIFIC MISCELLANY.

EXPLOSION OF STEAM BOILERS

BY JOHN W. HILL, M. E.,

A member of the American Society of Civil Engineers.

The alarming frequency of explosions, especially in the rural districts, demands that the attention of State Legislatures be directed to a speedy solution of the important problem of safety in the use of steam boilers. The interest of the public in a proper system of inspection of steam boilers is rapidly developing, and the necessity of such a surveillance of the manufacture and operation of this eminently useful and dangerous adjunct of civilization, as will reduce explosions to a minimum, is probably felt by all, however remotely interested in steam machinery.

What is required is the appointment of a Board of Inspectors in every State, to investigate and report upon every explosion, as well as to pursue a rigid system of inspection of the construction and use of steam boilers.

Whilst it is not imagined that such a Board could enter upon their duties sufficiently charged with information to prevent all explosions in the future, their association with work from year to year, and by frequent exchange of views with other similar Boards, would presently expand and develop their knowledge in a manner not to be attained by other processes.

It appears to the writer that the appointment of an engineer with a selected corps of assistants, to inspect all boilers now in use and recommend legal measures for the prevention of disastrous explosions in the future, would be quite as desirable a "luxury" as the usual Geological corps, for whilst the labors of the latter may improve our knowledge of the physical structure of our respective increments of the sphere, and open up avenues to unexpected wealth, the labors of the former will save priceless lives and property to the extent of millions.

That there are certain political objections to the inauguration of such a system is admitted, but the combined wisdom of our State law makers should be sufficient to meet the "legal" and "moral" impediments to a rigid law regulating the manufacture and use of steam boilers.

However this may be, no one who is a constant reader of the metropolitan daily papers can doubt the necessity of a careful system of inspection of the materials and workmanship employed in the construction of steam boilers, and in the use of the boiler after it is set to work.

The great majority of accidents are not with boilers in the hands of men who, from the force of circumstances, are supposed to have a certain knowledge of the "regimes" to be established in operating a steam boiler, but with the rural steam users whose knowledge is naturally very "limited," and as naturally very "dangerous." Whether the frequency of explosions in the "country" is the immediate result of the lack of appreciation of the dangers surrounding a seething boiler, or to impositions practiced on the unwary by knavish boiler makers in furnishing poor workmanship and defective materials, is a question to be determined. That poor workmanship and materials are often the "prime" cause of disastrous explosions is well known, and however this may be, a system of rigid inspection, by competent officials in every state, would speedily bring the construction and use of steam boilers to the proper level.

The system of inspection should embrace: The form of boiler as affected by the water in the locality in which it is to be used; the variability of load, and the fuel to be burned in the furnace; the dimensions as affected by maximum capacity required; the thickness of plates, class of riveting and caulking, and quality of iron to be used as affected by maximum pressure under which the boiler is to be worked; the test to be applied to the iron used, and the tests to be applied to the finished boilers; the manner of heating and purifying the feed water and its introduction into the boiler; the style of furnace to used and general arrangement for facility of inspection; the safety appliances, and standard of tests for "steam gauges," "safety valves," low water alarms and other devices applied to steam boilers.

Every steam boiler now in use, and every steam boiler made in the future should be subject to inspection, and a "seal" put upon it, and a certificate with restrictions under which it may be worked, furnished the owner, tampering with the one or exceeding the other to be visited with a severe punishment

In France a manufacturer cannot put in use a steam boiler without a permit from the prefect of the department. In making an application for "license" to purchase and put to work a steam boiler, the manufacturer addresses the prefect on a government blank furnishing the following information: Maximum pressure of steam under which the boiler is to work; horse power and class of connected engine; form of boiler desired; location of boiler in relation to buildings and public highway; fuel to be burned; nature of business conducted in the establishment, and plan of location (on separate sheet).

The prefect of the department refers the application to the prefect of the *arrondissement*, who in turn refers it to the mayor of the *commune*; this officer then proceeds to an investigation *de commodo et incommodo.* The investigation is continued for ten days; five days after its termination the mayor addresses the *proces-verbal* of the investigation, with his recommendation in the premises, to the prefect of the arrondissement who transmits it with his opinion to the prefect of the department. The prefect then lays the *proces* before the nearest government engineer, who examines and delivers an opinion upon which the decision of the prefect is based. This decree of 1810 (which as the writer is advised is still in force) in connection with an ordinance passed in 1843 relating to steam boilers, which provides that the boiler shall be tested— first, at the shop where it was built;

second, at the establishment where it is to be used—by the nearest government engineer, who after inspection furnishes the owner a certificate of condition and restrictions under which the boiler shall be operated. The tests are *obligatory* (except for mines) and give the manufacturer an *immunity* in the use of a steam boiler nowhere else approximated.

Under our system, or rather lack of system, the manufacturer buys and operates his boiler at his own option; if he desires to drive a forty horse-power engine with a twenty horse-power boiler, there is no law so far as the writer is aware to prevent his doing so.

The one great impediment to procuring a legal enactment relating to steam boilers is the general indifference of the public to the safety of human life. Take the preceding instance: If in carrying out the intention to drive a forty horse-power engine with the twenty horse-power boiler, the boiler "lets go," the public sympathy would be as great for the man who lost the boiler as for the men who lost their lives.

As an illustration of this, the writer would relate a circumstance happening several years ago:

A Steam boiler, furnishing power to a very large agricultural machine shop, exploded with terrible violence, demolishing one entire section of the building, and killing and injuring several of the workmen; the writer, coming on the ground a few minutes after the explosion, saw the workmen bearing off the corpse of one of the victims. Shocked at the sight, and desirous of ascertaining the extent of damage to life and limb, he suggested to a bystander "that it appeared to be a very rough accident;" the response came in a suppressed tone, "it was rough on Smith, he would be obliged to buy a new boiler." In this instance six men were killed and perhaps twenty seriously injured. It may not be out of place to remark that this was one of those rare cases where the engineer enjoyed the princely income of "six dollars a week."

In nearly every instance of boiler explosion, it appears that the usual legal investigation of the causes of the accident is a mere "farce," that neither determines the real nor proximate causes, or locates the blame where it properly belongs; and whilst the facts usually adduced at the inquest may form a foundation upon which the experienced engineer can build a theory of explosion, it is in the great majority of cases simply absurd to base a legal verdict upon the opinion of men whose knowledge of the steam boiler is of the most limited kind.

Several years ago a small cylinder boiler furnishing steam to a "digester" in a large soap and candle works in Cincinnati, suddenly "let go," killing the attendant and one of the factory hands on the spot; while a section of the shell weighing upwards of a thousand pounds passed directly up two or three hundred feet, thence westward nearly a half mile and fell, killing three small children.

At the inquest it was ascertained that no one but the attendant was to blame, and as he was already dead, the coroner "generously forebore to prosecute him;" at the same time the facts in this case as related to the writer by the previous attendant of the boiler, were such as to have condemned the proprietors to several years penal servitude, under the "boiler law" of Prussia.

Coupled with the lack of legal inspection, the general location of boilers in many of our large manufacturing establishments is reprehensible in the highest degree. In the city of Cincinnati there is a certain establishment covering a superfice of 300x200 feet, and lifting skywards seven stories.

Each of the floors except the basement, contains a small army of workmen, and thousands of dollars worth of costly materials and manufactured goods in various stages of completion. In the basement about as central as posts and stone pillars would permit, is located the battery of boilers furnishing the power to drive the machinery. Let us suppose an explosion in this case, what would be the probable results? Is it to be imagined that any large portion of the several hundred workmen shut up in this miniature Vesuvius would escape whole? By no means. Let the slender threads now linking safety to disaster loose their hold, and the pent up volcano would burst forth pouring human lava through the vent. Such an occurrence would fall upon the community like a mantle of darkness, and great would be the desire to locate the blame *somewhere.* The coroner would assume an air of marvelous concern, and swear by the party that put him in office, that the affair should be probed to the quick, and the fault brought home to its father, "though angels weep." To this end a jury would be struck, composed of distinguished citzens, with a plentiful *lack* of information on the questions to be brought before them, who after the usual delays would "on with the quest."

The picture may be highly colored, but the outlines are lifelike, as any one may verify who will read the testimony and the verdicts of the inquests following appalling accidents.

The fall of the Dixon bridge, the breaking of the Mill river dam, the Ashtabula horror, and the late total demolition of the Rockford court house, furnish excellent magazines of information upon the customary "legal" proceedings following these wholesale murders.

If we could have the inquest before the accident instead of after, how much better would it be; although this might seem "paradoxical," it is the spirit of the French law regulating the use of steam boilers, and an explosion in that country is a rare event.—*Van Nostrand's Engineering Magazine.*

Revolning Tail-Lights for Railway Trains.—An old proposal has been adopted on the Pennsylvania railroad for tail-lights. It is simply a flashing light produced by a revolving lamp worked by gearing in connection with the axle. It will be understood that when the train is standing still the light shines steadily in either red or white, but when the train is in motion the light rapidly changes from red to white and from white to red.

SCIENCE AT THE BRITISH ASSOCIATION.

The papers read at the recent session of the British Association at Plymouth, England, are quite rich in new scientific ideas. Their lengths precludes our touching on more than their salient points—but these will suffice to exhibit the wide and interesting range of the subjects discussed:

LIFE FROM OTHER WORLDS.

Sir William Thomson revived that curious paradox of the possibility of life coming upon our earth directly from other worlds—the vehicle being a meteorite. Biologists at present are not in accord as to what temperature is fatal to germ life; and it is believed that some germs come safely through extremes of temperature that are fatal to the species in a more advanced stage. On this rather doubtful foundation, Sir William bases his idea that a germ might hide away in a crevice of a meteorite, so that the intense heat of the interior might not reach it, and hence it might remain alive after the wandering mass had come to rest on the earth. One objection at least to this theory will suggest itself to the readers of Mrs. Ingram's interesting essay—read before the American Association, at Nashville, Tenn.—and that is, if that fair scientist is right about concussion being fatal to germ existence, then the shock of the meteorite striking the earth, if not due to its contact with the atmosphere, would be quite sufficient to destroy the traveling organisms.

THE INDUSTRIAL VALUE OF SCIENTIFIC RESEARCH.

Professor Abel made a capital review of the operation of purely scientific research in developing important branches of industry. He instanced Perkins' researches in the coal tar colors, and more especially referred to the recent improvements in the steel manufacture. He pointed out that the success which has attended the addition of silicon in combination with iron and manganese to the steel before casting in the preventing the formation of blow-holes, and in contributing at the same time to the production of the particular character of steel required, bids fair to be of special importance in connection with the application of steel to the production of projectiles for use against armor plates and of castings which will compete successfully with carefully forged metal, or even with the Whitworth compressed steel. He also alluded to the advantages of steel armor over iron, and stated that promising results have recently been obtained at Shoeburyness with a new system of applying steel in conjunction with malleable iron, by which a perfect union of the two materials at one of their surfaces is obtained by the aid of heat. Reference was also made to the late investigations into the physical nature of gunpowder, which among other things have demonstrated that modifications in composition, not unimportant from an economical point of view in dealing with the very large charges now employed, may materially contribute to render the storing of the maximum of work in the projectile, when propelled from a gun, compatible with a subjection of the gun to comparatively very moderate and uniform strains.—*Scientific American.*

EDITORIAL NOTES.

KANSAS CITY ACADEMY OF SCIENCE.—The regular monthly meeting of the Kansas City Academy of Science will be held at its rooms, on the evening of Tuesday, Oct. 30, 1877. A paper on "Cone Sections" will be read by Prof. J. M. Greenwood, of this city. It is expected that Prof. Mudge, State Geologist of Kansas, will be present and favor the audience with an account of his palæontological discoveries in Colorado during the past summer.

IN our list of the officers of the American Association for the Advancement of Science, given last month, we inadvertently omitted the name of Prof. G. S. Blackie, of Nashville, Tenn., who was elected Chairman of Permanent Subsection of Microscopy.

ON October 14th, the steamer Olga, which was towing the caisson containing Cleopatra's needle, was compelled to abandon it during a heavy gale off Cape Finisterre. Fortunately, however, the steamer Fitz Maurice recovered it the next day ninety miles north of Ferrol, Spain.

OREGON, MO., Oct. 16, 1877.

COL. CASE: *Dear Sir*—Herewith find a fragment of a stump, recently uncovered by the action of a stream of water, on the farm of A. J. Tolby, in the N. E. corner of sec. 19, town. 62, range 38, in this county. The top of the stump, which is uneven, was, 5 years ago, 5 ft. below the surface. It is now uncovered to the depth of one foot, disclosing the tops of the roots. The diameter is 15 inches one way and 18 inches another; the color of the wood is black, as in the specimen; the wood is probably burr-oak, colored by the action of the water. The location is upland prairie, with no timber near. The surface of the ground was originally covered by blue stem grass, over which the spring branch ran for centuries, perhaps, until the place was improved by Mr. Tolby. The spot where the stump stands is now enclosed in a lane lot, and as soon as the stock had killed the grass the stream began to wash a channel in the loose, black soil, underneath, when the stump was exposed. The stump is within a short distance of the source of the branch.

Respectfully yours,
WM. BAUCHER.

This kind of wood is often found in alluvial deposits, having been left by overflows or washed down from the hills in some bygone age. It is something similar to the black bog oak, found in the Peat beds of Ireland and other countries. The same condition of wood is often found in the sand-bars and banks of the Missouri River. After a long deposit in the water the wood undergoes a kind of carbonization, and with the requisite pressure and heat would in time become coal.—ED.

WE are indebted to Prof. Geo. Halley, of this city, for preparing and arranging the extended report of the proceedings of the Kansas Academy of Science, which makes the first article of the REVIEW. After it was in print we received the official report from the Secretary, Mr. A. E. Popenoe, from which we learn additionally that the following named gentlemen were elected officers for the ensuing year, viz:

President—F. H. Snow, of Lawrence.

Vice Presidents—B. F. Mudge, of Manhattan, and J. H. Carruth, of Lawrence.

Secretary—Edwin A. Popenoe, of Topeka.

Treasurer—R. J. Brown, of Leavenworth.

Curators—F. H. Snow, W. K. Kedzie and E. A. Popenoe.

Prof. Halley is enthusiastic in his praises of the energy, industry and genuine scientific spirit of the Kansas Academy, and predicts a most interesting meeting and a rare treat to our citizens next June.

THE AMERICAN CONGRESS AT LUXEMBOURG.—The second International Congress of Americanists, or students of American archæology, philology and pre-Columbian history, was held at Luxembourg, September 10 to 13, and proved a decided success. The visitors, who represented most of the countries of Europe and South America, were most hospitably treated by the inhabitants, who entertained them at a civic banquet on the 14th of September. Some highly interesting communications were made, of which, perhaps, the most important were the following:

1. "Papers on the Ancient Mound Builders and Pueblos of New Mexico," by Messrs. Edwin A. Barber, R. Robertson, H. Gillman, Stephen Peet and M. F. Force.

2. Papers on "The Antiquities of Greenland and the Primitive Habitat of the Esquimaux," by Messrs. Waldemar Schmit and Dr. Rink.

3. Papers on "American Hieroglyphics, Ethnology and Civilization," by Professor Leon de Rosny, Hyde, Clarke, Madier de Montjau, F. A. Allen, Schwab, Malte Brun, Ttronck, Abbe Pinart, Dr. Leemans, of Leyden, &c.

4. "Philological Treatises upon the American Language," by Messrs. Henry, F. H. Moore and Lucien Adam, the last of whom presented an elaborate comparison of the grammar of sixteen Indian nations.

5. Historical papers, such as upon the "European Colonies in Markland," by E. Beauvoisin; "Comparison between Mexican and Peruvian Legislation," by M. Nodal, and other papers.

6. Several geological treatises, such as one upon "The Stone Age in America," by M. Guimet, of Lyons.

It is proposed to hold the third Congress (1879) at Brussels.

BOOK NOTICES.

The Animal Kingdom, by W. Bingley, A. M. 1122 pages octavo; over 1000 engravings. Published by Hubbard Bros., Phila.; 1877.

This work is a very comprehensive though popular record of zoology, comprising graphic descriptions of nearly all known species of beasts, birds, fishes, insects, reptiles, mollusks and animalculæ all over the world, prepared, as the author states, after laborious personal research, with the aid of the works of Cuvier, Buffon, Wood, Dallas, Wilson, Audubon, Nuttall, Bonaparte, Agassiz, Jardine, Brewer and many others. Not less than 500 different members of the animal kingdom are described, and some of them at considerable length, such as the apes and monkeys, of which 26 varieties are discussed in full, some of which, as the Proboscis monkeys, are very little known. The birds are very fully described, nearly 400 pages being devoted to them. Every department of zoology has received equal attention, and the work is one that reflects credit upon the publishers. While it is not adapted to the use of college professors and scientific *Savans*, nor intended for such, it must necessarily be just what is needed by the teachers in our schools and by the heads of families, for use in the instruction of children; for such purposes the descriptions are sufficiently technical and minute, at the same time that they are written in an easy and attractive style, well calculated to make a lasting impression upon the mind of the general reader. The illustrations are exceptionally good, and the whole make-up of the work unusually complete. It must meet with a ready sale on its merits alone. The publishing house is represented here by Mr. L. L. Boynton, who is extending his agencies in all directions.

The Engineering and Mining Journal. Oct. 13, 1877. No. 15, Vol. 24. Quarto; pp. 18. Weekly. Scientific Publishing Co, 27 Park Place, New York. $4.00 per annum; single numbers, 10 cents.

This well known periodical, including the *Coal and Iron Record*, of New York, and the *Mining Review*, of Denver, Col., is edited by Richard P. Rothwell, C. E., M. E., and Rossiter W. Raymond, Ph. D., and is devoted to mining, metallurgy and engineering, being the leading journal of the kind in this country. Messrs. Van Wagener and Rose are in charge of the Denver branch office, while Don Antonio Del Castillo is the staff correspondent in the city of Mexico. It contains a great deal of matter most interesting and valuable to western readers and all others who desire to keep themselves apprised of the progress of mining and engineering in the Rocky Mountains.

Science Observer. Vol. 1, No. 4. Boston, September, 1877. Published monthly by the Boston Amateur Scientific Society. Price, 25 cents.

This is a small, unpretentious, 8-paged paper, called by its editors a "Journal for Amateur

Scientists," but if we were to judge by the contents of the present number, which is made up principally of astronomical articles of a high scientific character, we should say that it was rather a journal for experts. The first article, "On the diameter of the Satellites of Mars," certainly evinces first-rate mathematical ability on the part of its writer, while that upon "Recent Double Star Observations," taken in connection with those on the same subject in previous numbers, would do credit to any scientific journal in the country.

WOMEN'S SECRETS, OR HOW TO BE BEAUTIFUL, translated and edited from the Persian and French, with additions from the best English authorities, by Lou. Capsadell, New York. The Author's Publishing Co. 1876. pp. 60. Price, 75 cents.

Despite the *ad captandum* title of this little work it contains many very valuable and useful statements, hints and suggestions to ladies in regard to the all important subjects of "prolonging the freshness of youth and perpetuating the roseate charms of womanhood," not by means of cosmetics and lotions, but by applying the rules of physiology and hygiene in all the acts and duties of life. These rules are given in an easy style, and if followed out will undoubtedly go far towards accomplishing the object. In addition, there are instructions for the toilet, rules for raising beautiful children, for eating, for sleeping, for bathing, for producing fat and for producing leanness, warnings against the destruction of beauty, and finally, instructions for remaining beautiful. For sale by H. H. SHEPARD.

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS, by H. Carrington Bolton, Ph. D. Reprinted from the annals of the New York Academy of Sciences, Vol. 1, 1877.

The author of this paper, who was elected General Secretary of the American Association for the Advancement of Sciences, (and not Vice President, as the punctuation of our notice in the September number of the REVIEW makes us say), advocates the use of organic acids in the decomposition of minerals for the purpose of analysis, on the ground that they are more readily and safely transported during field explorations, and that our preconceived notions of their weakness as regards minerals are erroneous. His experiments were made upon carbonates, sulphides, oxides, sundries and silicates principally, with citric, tartaric and oxalic acids, but a few tests were made with malic, fornic, acetic, benzoic, hydrogallic and picric acids. Of the solid acids, solutions saturated in the cold were used; of the liquid acids, ordinary commercial products, and the tests were conducted with a view to their possible application in field work. It is impossible to do more than to give briefly the results of a large number of interesting experiments, in which the action of organic acids upon various minerals is compared with that of hydrochloric acid. They are claimed to be about as follows: They not only decompose a considerable number of minerals belonging to various groups but also possess a remarkable selective power as regards the degree of this decomposition. Many of the reactions are simple, quickly applied, characteristic and sensitive; they may be used in distinguishing minerals nearly related and probably in separating minerals mingled in one specimen. In addition, the author suggests that the chemistry of geological changes may be more fully and clearly understood by considering the value of the organic acids in the work of disintegration and consolidation. The subject is a very interesting one and demands the attention of mineralogists and geologists.

CONTRIBUTIONS TO THE TREATMENT OF PULMONARY PHTHISIS, by Dr. W. Gleitsmann, reprinted from New Orleans Medical and Surgical Journal, July, 1877.

This is a pamphlet written in the interest of a Sanitarum located at Ashville, N. C., and managed by the writer. His main points are that air, exercise and cold water, all of the proper quality, are the essentials in the care of consumption, and that these requisites are to be found at Ashville in a greater degree of perfection than almost anywhere else.

TRANSACTIONS OF THE KANSAS ACADEMY OF SCIENCE, Volume V., Topeka, Kansas, 1876; pp. 14.

Though rather late in appearing, the transactions, reports and papers of the ninth annual meeting are very interesting and instructive, and the mechanical work very handsomely done by the state printer.

The following is a list of the papers published, viz:

1. Annual Report of the Committe on Geology for the year ending November 1st, 1876, by Prof. B. F. Mudge.

2. Climate and Brains, by M. V. B. Knox.

3. Bison Latifrons in Kansas, by Prof. B. F. Mudge.

4. Habits of Prairie Dogs, by H. H. Brons.

5. Habits of Amblychila Cylindriformis, by H. H. Brons.

6. The Waconda Meteorite, by Prof. G. E. Patrick.

7. The Iola Gas Well, by Prof. G. E. Patrick.

8. List of Colorado Coleoptera, by Prof. F. H. Snow.

9, List of Kansas Coleoptera, by Edwin A. Popenoe.

10. Centennial Catalogue of Plants of Kansas, by Prof J. H. Carruth.

11. Meteorological Summary for 1876, by Prof. F. H. Snow.

12. Locust Flights East of the Mississippi, by Prof. C. V. Riley.

13. Additions to Kansas Mammalia, by M. V. B. Knox.

14. Influence of Food, selection upon the evolution of animal life, by Dr. A. H. Thompson.

15. Evidence of Ancient Forests in Central Kansas, by H. C. Turner.

16. The River Bluffs, by Prof. J. D. Parker.

INTRODUCTION AND SUCCESSION OF VERTEBRATE LIFE IN AMERICA, by Prof. O. C. Marsh, Yale College. 57 pp.

This is an address delivered before the American Association for the Advancement of Science, at Nashville, August 30, 1877, and is probably the most complete and thorough review of the subject that has ever been published. Having received it but a day or two since, we can only do it justice by postponing its consideration until our next number.

THE October number of the *American Naturalist* opens with an interesting sketch of "The Surface Geology of Eastern Massachusetts," by W. O. Crosby; "Pseudis, the Paradoxical Frog," by S. W. Garman, follows, with an illustration. Edwin A. Barber, in his paper "On the Ancient and Modern Pueblo Tribes of the Pacific Slope of the United States," endeavors to answer the enigmatical question, "Who are the architects of the extensive prehistoric stone structures which abound in New Mexico, Arizona, and other portions of the Southwest?" S W. Williston discusses, *con amore*, "The American Antelope;" John A. Ryder touches closely upon the Darwinian Philosophy in his "Laws of Digital Reduction;" and David S. Jordon closes the list of long papers, with a very complete article "On the Distribution of Freshwater Fishes." The recent publications relating to Natural History are fully and carefully reviewed by the editor;—fourteen pages are devoted to new discoveries and advances made in the various sciences of Botany, Zoology, Microscopy, etc.,—the whole closing with Scientific News and Proceedings of Societies. Published by H. O. Houghton and Company, Boston. Terms: $4.00 a year, 35 cents a number.

OTHER PUBLICATIONS RECEIVED.

Engineering and Mining Journal, New York; weekly.................................. 10c.
Van Nostrand's Eclectic Engineering Magazine; monthly............................ 50c.
Popular Science Monthly, November...... 50c.
Mines, Metals and Manufactures, St. Louis; weekly................................ 10c.
Science Observer, Boston; monthly........ 25c.
Weather Review, War Dept.; monthly..... .....
American Naturalist, Boston; monthly... 35c.
Scientific American, New York; weekly.. 10c.
Remarks upon Sulphate of Quiniæ, by Alexander H. Jones.
Contributions to the Treatment of Pulmonary Phthisis, by W. Gleitzmann, M. D.
Biennial Report of the Mountain Sanitarium for Pulmonary Diseases, by W. Gleitzmann, M. D.
Programme of the American Association for the Advancement of Science, Nashville, Tenn., Tuesday, September 4, 1877.
Report of Bureau of Vital and Statistics, New York.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

VOL. 1. NOVEMBER, 1877. NO. 9.

ASTRONOMY.

On the Dispersion of Heat and Forces capable of producing the Heat and Light and all the Resultant Phenomena in the Solar System.

BY JUDGE E. P. WEST, KANSAS CITY, MO.

If we accept the nebular hypothesis as true, as most of the astronomers of the present day, I believe, do,—and nothing accounts so well for all the known phenomena of the solar system,—we must believe that the heat of the sun and of all the planets and their satellites is gradually being dissipated, and that ultimately, unless some unknown source of heat is supplying the waste, they will become cold, dead bodies, inactive so far as heat and its attendant phenomena affect them.

It is true that Mr. Proctor, in a recent address,* claims that our world has been partly, at least, built up by accretion, but there is no sufficient evidence to sustain this position. There is nothing to prove that our earth has been increased perceptibly by this cause. If we admit that it has been so increased, we must assume that there was formerly a much greater indrawing of extrinsic matter than now, an assumption we have no sufficient reason to indulge. We have as much reason to believe that the fall of me-

*Address before the Kansas City Academy of Science, 1876.

teors is greater now than formerly, as to believe that it was greater formerly than now. But Mr. Proctor does not deny, on the contrary he claims, that the nebular hypothesis is true in part. If true in part it may be true in all, and this he admits. If we consider our own planet, we find evidence deeply interwoven in its entire structure which clearly unfolds a past history widely different from its present condition. There is evidence of a former far greater degree of heat than we experience now; heat so intense, indeed, that after passing a probable stage in which all of our metals and solid rocks were held in incandescent vapor, a stage was reached in which they were still held in a vast, glowing, molten mass so intensely heated as to drive off in a gaseous vapor all of the waters now collected in our vast oceans, and to hold them suspended in a cloud envelope of great thickness. From this condition the earth has gradually cooled down, by a slow dispersion of its heat, to its present condition. Judging from what has taken place in the past, we have reason to believe that this dispersion of heat will continue until the entire heat force of the earth is exhausted; until the earth becomes a cold, dead body, destitute of life, as we now find its attendant satellite. The moon is believed to be now destitute of heat, destitute of life, and destitute of an atmosphere and of water upon its surface; its face pitted over with deep valleys, environed by high mountains; the mountain shadows so vast as to be seen with the naked eye. This manifest display of former volcanic action gives unmistakeable evidence of immense past forces caused by internal heat; forces which long since have ceased. The atmosphere and water, which no doubt prevailed on the moon's surface during its active stage, have disappeared, probably swallowed up in some other form in its interior.

If we consider the inner planets, those nearer the sun than the earth, and conforming nearest to it in size, we find their present condition very similar to that of the earth. If we look to the larger outer planets, especially to Jupiter and Saturn, we find them still in a state of glowing heat, with the water, which will be ultimately collected together upon their surfaces in vast oceans, now held in vapor, enveloping them in vast cloud masses. The great ruler of the day, the mighty sun, whose mass is so superior to all of its attendant planets, and to which it has given birth, is still far more intensely heated than any of them. His heat is so intense, indeed, as to drive off his lighter metals, such as iron, nickel, sodium, &c., in vapor, as our water is suspended in vapor in the earth's atmosphere. Such is believed to be the present condition of our solar system by those most distinguished in physics.

If the sun and planets have a common origin, the degree of heat intensity must have been at one time homogeneous, and the difference now prevailing the result of separation and consequent difference in mass, which destroyed the former homogeneity by changed condition or relation. It is well known that a small body, heated to the same degree, loses its heat much sooner than a larger one.

If the heat of the solar system be motion, undulation, or vibration, and is continually being diminished, it may be assumed to be but transitory, and must have had a beginning, as there will be a time when it will entirely cease in its near relation to our solar system. There must, too, have been a cause adequate to give rise to the motion, undulation, vibration, or heat. Now, what force could give rise to the vast volume of heat contained in the whole mass of matter of the solar system, while suspended in incandescent vapor, but the ultimate force of the entire mass of matter itself drawn in and hurled together by its own unresisted attraction? Any less power would be inadequate to its production. That motion may be converted into heat, and heat into motion, we see continually and familiarly illustrated. Take a piece of wire between your thumb and finger, bend it rapidly back and forth, and heat too great for the hand to endure will soon be produced. Strike rapidly, with a hammer, on a bar of iron—heat is the result. Take a bar of steel with a blunt end, apply the end to a rapidly-revolving emery-wheel, take hold of the middle of the bar with one hand, and with the other grasp the opposite end—the hand in the center will experience no heat, while the end grasped by the other hand will soon become so hot that the hand cannot endure it. This is caused by the obstruction offered by the hand to the heat waves, set in motion by the emery-wheel. A thermometer placed at the end of the bar will not indicate a greater degree of heat, because it offers no resistance to the heat waves. A ball discharged from a cannon, coming in contact with a stationary solid body, or with another body moving rapidly in an opposite direction, becomes greatly heated, as, also, would the body in motion coming in contact with it. Now, the heat so generated, after its cause has ceased, itself ceases, being gradually dissipated, and the heated substance becomes cold. The dispersion is in proportion to the mass of the body heated and the amount of resistance offered to the vibration or heat waves. A small body will lose its heat sooner than a large one, other conditions being equal.

Heat, then, may have its origin in motion or arrested motion, and when so originated is not permanent, but passes gradually away. The largest-sized cannon-ball, heated to redness, soon loses its heat and becomes cold, when the cause of its heat ceases.

Suppose two cold balls or globes a mile in diameter, composed of all the elements of which the solar system is made up, moving in opposite directions, could be thrown together, each moving with a velocity of a hundred miles per second, the heat imparted to them by the arrested motion—which would be in proportion to the velocity with which they came in contact—would be sufficient to drive off the matter of which they were composed in an incandescent gaseous condition. If they were removed beyond the influence of any attraction greater than their own, they would expand in consequence of the heat generated by the impact, until the expansive force of the heat was overcome by the central attractive force of the mass. When the catastrophe which generated the heat was over, the dispersion of the heat generated would begin, and would continue until the entire heat force was exhausted, and the mass become cold. During this gradual dispersion of heat, the mass of matter would gradually shrink. Now, suppose this mass, while so intensely heated and expanded, should be revolving on its own axis, by which a force or tendency to throw off was established at its outer surface, it is probable that the central indrawing attractive force would be overcome on the extreme outer surface by this counter force, or tendency to throw off, leaving rings at the outer surface. These rings would have themselves a center of attraction peculiar to themselves, and would be ultimately drawn together around a common center. Now, suppose these bodies thrown off to vary in mass, the smaller ones would lose their heat in less time than the larger ones, and we should find the different parts of the original mass so separated varying in intensity of heat, and this variation or difference in degree would continue until the dispersion of heat from all of them was complete.

Heat, then, may be considered an accident of matter, which may be called into existence and dispersed by certain of its phases. Light dependent on heat, and perhaps also electricity may be placed in the same category. But you may perceive that in our supposed globes or balls, while heat, light, and perhaps electricity, are but evanescent, there is one force which is constant—a force "without variation or shadow of change"—a force which says to the expansion of heat, "Thus far shalt thou go, and no farther." I mean the great force of attraction, which is as silent, as constant, as durable, as time itself. Heat, light, life—all are the direct or indirect results of this silent force. The genial heat and light, which give life and beauty to the vast surface of our earth, are but the unexpended remnant of the heat and light called into being by a former collision of the sun and his attendant planets, caused by the ever-present, unrelenting force of attraction. We will suppose the heat of the solar system, as in case of our balls or globes, to be entirely dispersed, and the whole mass of matter of which the solar system is composed, like them, hurled together, the heat generated by the impact would be so great as to throw off its entire matter in an incandescent gaseous or nebulous condition. But this would not destroy, effect, or change the attractive force. On the contrary, the expansive force of the heat thus generated would be, within definite limits, overcome by the central attractive force. A dispersion of heat and a shrinkage or indrawing of the matter would begin. Rings would be formed by the opposing centripetal and centrifugal forces; these rings would be each drawn to a common center, and a system of worlds similar to those of our present solar system would be the result. How often it has undergone these changes is beyond the power of the imagination to conceive. Like the fabled Phœnix, our solar system, with all its manifold, varied and mysterious life, rises into new life and vigor from the ashes of its own ruin. While we find inherent in matter forces sufficiently potent to generate all of the heat and light of the solar system, with all their resultant phenomena,—forces capable of "rolling the heavens and earth together as a great scroll," and "melting them in fervent heat,"—and that such forces have been exerted and may be exerted again, I may safely assure my friends that they are in no immediate danger from this cause, and that this generation *will* "pass away before these things shall be."

The cause of attraction is not known, but may yet be found in magnetism. The motions of the heavenly bodies, as well as attraction, may possibly be found in the two-fold forces of electricity and its kindred mystery, magnetism. But I cannot pursue this branch of the subject now without the risk of wearying your patience, and shall have to defer it to some future occasion when time and opportunity offers.

MOONLIGHT.*

BY RICHARD A. PROCTOR, B. A.

The light of the moon and the changes of the moon were probably the first phenomena which led men to study the motions of the heavenly bodies. In our times, when most men live where artificial illumination is used at night, we can scarcely appreciate the full value of moonlight to men who cannot obtain artificial light. Especially must moonlight have been valuable to the class of men among whom, according to all traditions, the first astronomers appeared. The tiller of the soil might fare tolerably well without artificial light, though even he—as indeed the familiar designation of the harvest moon shows us—finds especial value, sometimes, in moonlight. But to the shepherd moonlight and its changes must have been of extreme importance as he watched his flocks and herds by night. We can understand how carefully he would note the change from the new moon to the time when, throughout the whole night, or at least of the darkest hours, the full moon illuminated the hills and valleys over which his watch extended, and thence to the time when the sickle of the fast-waning moon shone but a short time before the rising of the sun. To him, naturally, the lunar month, and its subdivision, the week, would be the chief measure of time. He would observe—or rather he could not help observing—the passage of the moon around the zodiacal band, some twenty moon breadths wide, which is the lunar roadway among the stars. These would be the first purely astronomical observations made by man; so that we learn without surprise, that before the present division of the zodiac was adopted, the old Chaldean astronomers (as well as the Indian, Persian, Egyptian and Chinese astronomers, who still follow the practice), divided the zodiac into 28 lunar mansions, each mansion corresponding nearly to one day's motion of the moon among the stars.

It is easy to understand how the first rough observations of moonlight

"* The Day of Rest."

and its changes taught men the true nature of the moon, as an opaque globe circling round the earth, and borrowing her light from the sun. They perceived, first, that the moon was only full when she was opposite the sun, shining at her highest in the south at midnight when the sun was at his lowest beneath the northern horizon. Before the time of full moon, they saw that more or less of the moon's disk was illuminated as he was nearer or farther from the position opposite the sun, the illuminated side being towards the west—that is, towards the sun; while after full moon the same law was perceived in the amount of light, the illuminated side being still towards the sun, that is, towards the east. They could not fail to observe the horned moon sometimes in the day time, with her horns turned directly from the sun, and showing as plainly, by her aspect, whence her light was derived, as does any terrestrial ball lit up either by a lamp or by the sun.

The explanation they gave was the explanation still given by astronomers. Let us briefly consider it. In doing so I propose to modify the ordinary text-book illustration which has always seemed to me ingeniously calculated (with its double set of diversely illuminated moons around the earth) to make a simple subject obscure.

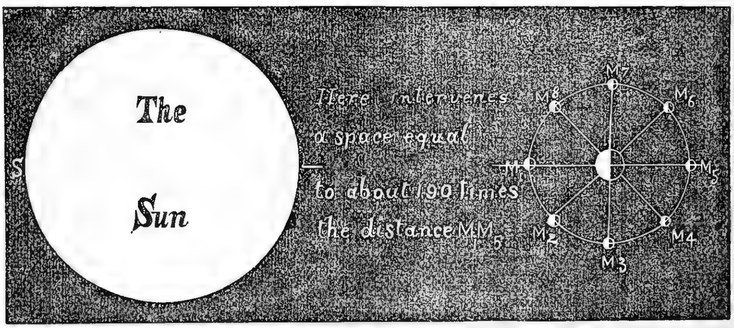
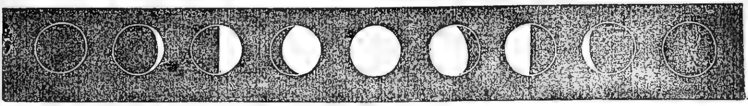


FIG. 1.

In Fig. 1, let E represent the earth one half in darkness, the other half illuminated by the rays of the sun, S, which should be supposed placed at a much greater distance to the left, in fact about five yards away from E. To preserve the right proportions, also, the sun ought to be much smaller and the earth a mere point. I mention this to prevent the reader from adopting erroneous ideas as to the size of these bodies. In reality it is quite impossible to show, in such figures, the true proportions of the heavenly bodies and their distances. Next let M, M^1, M^2, M^3, etc., represent the moon in different portions along the circuit around the earth at E.

Now, it is clear that when the moon is at M^1, her illuminated face is turned from the earth, E. She, therefore, cannot be seen, and accordingly, in Fig. 2, she is presented as a black disk at 1 to correspond with her invisibility when she is at M^1. She passes on to M^2, and now from E a part of her illuminated half can be seen towards the sun, which would be towards the right if we can imagine an eye at E looking towards M^2. Her appearance then is shown at 2, Fig. 2. In any intermediate portion between M and M^2, the sickle of light is visible but narrower. We see also that all



1 2 3 4 5 6 7 8 9

Fig. 2.

this time the moon's place on the sky cannot be far from the sun's place, for the line from E to M^2 is not greatly inclined to the line from E to S. When the moon has got around to M^3, the observer on the earth sees as much of the dark half as of the bright half of the moon, the bright half being seen, of course, toward the sun. Thus the moon appears at 3, Fig. 2. Again as to position, the moon is now a quarter of a circuit of the heavens from the sun, for the line from E to M^3 is square to the line from E to S. We see similarly that when at M^4 the moon appears as shown at 4, Fig. 2, for now the observer at E sees as small a part of the moon's dark side as he had seen of her bright side when she was at M^2. When she is at M^5, the observer at E sees her bright face only, the dark face being turned directly from him. She, therefore, appears as at 5, Fig. 2. Also being now exactly opposite the sun, as we see from Fig. 1, she is at her highest when the sun is at his lowest, or midnight; and, at this time, rules the night as the sun rules the day.* As the moon passes on to M^6, a portion of her dark half comes into view, the bright side being now towards the left, as we look at M^5 from E, Fig. 1. Her appearance, therefore, is as shown at 5. When at M^7 she is seen at 7, half bright and half dark, as when she was at M^3, but with the halves interchanged. At M^8 she appears as at 8, and, lastly, at M^1 she is again undiscernible.

The ancient Chaldæan astronomers could have little doubt as to the validity of this explanation. In fact, while it is the explanation obviously suggested by observed facts, one cannot see how any other could have occurred to them.

But if they had had any doubts for a while, the occurrence of eclipses would soon have removed those doubts. They must early have noticed that at times the full moon became first partly obscured, then either wholly disappeared or changed in color to a deep coppery red, and after a while

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* It has been thought by some that, in the beginning, the moon was always opposite the sun, thus always ruling the night. Milton thus understood the account given in the first book of Genesis. For he says:

Less bright the morn
But opposite in levell'd west was set
His mirror, with full force, borrowing her light
From him; for other light she needed none
In that aspect; and still that distance keeps
Till night, then in the east her turn she shines
Revolv'd on Heav'n's great axle.

It was only as a consequence of Adam's transgression that he conceives the angels sought to punish the human race by altering the movements of the celestial bodies:

To the blank moon
Her office they prescribe—

It is hardly necessary to say, perhaps, that this interpretation is not scientifically admissible.

reappeared. Sometimes the darkening was less complete, so that at the time of greatest darkness a portion of the moon seemed eaten out, though not by a well-defined or black shadow. These phenomena, they would find, only at the time of full moon. And if they were closely observant, they would find that these eclipses of the moon only occurred when the full moon was on or near the great circle round the stellar heavens, which they had learned to be the sun's track. They could hardly fail to infer that these darkenings of the moon were caused by the earth's shadow, near which the moon must always pass when she is full, and through which she must sometimes pass more or less fully; in fact, whenever, at the time of full, she is on or near the plane in which the earth travels round the sun. Solar eclipses would probably be observed later. For though a total eclipse of the sun is a much more striking phenomenon than a total eclipse of the moon, yet the latter are far more common. A partial eclipse of the sun may readily pass unnoticed, unless the sun's rays are so mitigated by haze or mist that it is possible to look at his disk without pain. Whenever solar eclipses came to be noted, and we know from the Chaldæan discovery of the great eclipse period, called the *Sgros*, that they were observed at least two thousand years before the Christian era, the fact that the moon is an opaque body circling round the earth, and much nearer to the earth than the sun is, must be regarded as demonstrated. Not only would eclipses of the sun be observed to occur only when the moon was passing between the earth and the sun, but in an eclipse of the sun, whether total or partial, the round black body cutting off the sun's light wholly or partially would be seen to have the familiar dimensions of the lunar orb.

Leaving solar and lunar eclipses for description, perhaps, on another occasion, I will now proceed to consider a peculiarity of moonlight which must very early have attracted attention—I mean the phenomenon called the harvest moon.

The moon circuits the heavens in a path but slightly inclined to that of the sun, called the ecliptic, and for our present purpose we may speak of the moon as traveling in the ecliptic. Now we know that during the winter half of the year the sun is south of the equator: the circle of the heavenly sphere which passes through the east and west horizon, and has its plane square to the polar axis of the heavens. During the other or summer half of the year he is north of the equator. In the former case the sun is above the horizon less than half the twenty-four hours, day being so much the shorter as the sun is farther south of the equator; whereas in the latter case the sun is above the horizon more than twelve hours, day being so much the longer as the sun is farther north of the equator. Precisely similar changes affect the moon, only, instead of taking place in a year (the time in which the sun circuits the stellar heavens), they occur in what is called a sidereal month, the time in which the moon completes her circuit of the stellar heavens. For about a fortnight the moon is above the horizon longer than she is below the horizon, while during the next fortnight she is below the horizon longer than she is above the horizon. Now, clearly, when the length of what we may call the moon's diurnal path (meaning her path above the horizon), is lengthening most, the time of her rising on successive nights must change least. She comes to the south later and later each successive night by about 50½ minutes, because she is always traveling towards the east at such a rate as to complete one circuit in about four weeks; and losing thus one day in 28, she loses about 50½ minutes per day. If the interval between her rising and arriving to the south were always the same, she would rise 50½ minutes later night after night. But if the interval is lengthening, say 10 minutes per night, she would of course rise only 40½ minutes later; if the interval is lengthening 20 minutes per night she would rise only 30½ minutes later, and so forth. But the lunar diurnal arc *is* lengthening all the time she is passing from her position farthest south of the equator to her position farther north, just in the same way as the solar day is lengthening from midwinter to midsummer, only to a much greater degree. And as the solar day lengthens fastest at spring when the sun crosses the equator from south to north, so the time the moon is above the horizon lengthens most, day by day, when the moon is crossing the equator from south to north. It lengthens, *then*, from an hour to an hour and 20 minutes in one day, that is the interval between moonrise and moonsetting increases from 30 to 40 minutes. At this time, then, whenever it happens in each lunar month, the moon's time of rising changes least—instead of the moon rising night after night 50½ minutes later, the actual difference varies only from 10 to 20 minutes.

Now when this happens at a time when the moon is not nearly full, it is not specially noticed, because the moon's light is not then specially useful. But if it happens when the moon is nearly full, it is noticed, because her light is then so useful. A moon nearly full, afterwards quite full, and then for a day or two still nearly full, rising night after night at nearly the same time, remaining also night after night longer above the horizon, manifestly serves man for the time being in the most convenient way possible. But it is clear that as the full moon is opposite the sun, and as to fulfill the condition described we have seen that she must be crossing the equator from south to north, the sun, opposite to her, must be at the part of his path where he crosses the equator from north to south. In other words, the time of year must be the autumnal equinox. Thus the moon which comes to "full" nearest September 22 or 23 will behave in the convenient way described. At this time, moreover, when she rises night after night at nearly the same time, the nights are lengthening the fastest while the time the the moon above the horizon is lengthening still more — and, therefore, in all respects the moon is then doing her best, so to speak, to illuminate the nights. At this season the moon is called the harvest moon, from the assistance she sometimes renders to harvesters.

The moon which is full nearest to September 22–23, may precede or follow that date. In the former case only can it properly be called a harvest moon. In the latter it is sometimes called the hunter's moon. The full moon occurring nearest to harvest time will always partake more or less of the qualities of a full moon occurring at the autumnal equinox, and similarly of a full moon following the autumnal equinox. So that, in almost every year, there may be said to be a harvest moon and a hunter's moon. But, of course, it will very often happen that in any particular agricultural district the harvest has to be gathered in during the wrong half of the lunar month, that is, during the last and first, instead of the second and third quarters.

The reader must not fall into the mistake of supposing, as I have seen sometimes stated in text-books of Astronomy, that we are more favored in this respect than the inhabitants of the southern hemisphere. It is quite true that the same full moon shines on us as on our friends in New Zealand, Australia, and Cape Colony, and also that our autumn is their spring, and their spring our autumn. But the full moon we have in autumn behaves in the southern hemisphere not as with us, but as our spring moon behaves; and the full moon of our spring, which is their autumn, behaves with them as our autumn moon behaves with us. It is, therefore, for them a harvest moon if it occur before the equinox, and a hunter's moon if it occur after the equinox. A very little consideration will show why this is. In fact if, in the explanation given above, the words north and south be interchanged, and March 21–22 written for September 22–23, the explanation will be precisely that which I should have given respecting the harvest (or March) moon of the southern hemisphere, if I had been writing for southern readers.

GEOLOGY.

On Critical Periods in the History of the Earth, and their Relation to Evolution; On the Quaternary as Such a Period.

BY JOSEPH LECONTE.

[CONTINUED.]

I have preferred, thus far, to speak of *general* evolution-changes of organisms, whether slow or rapid, as produced by varying pressure of external conditions, and of the most striking *local* changes by migration from other regions, where the apparently suddenly-appearing species had previously existed, having originated there by evolution in the usual way. I have chosen, thus far, to represent the organic kingdom as lying, as it were *passive* and plastic under the molding hands of the environment. I have done so because it is in accordance with true method to exhaust the more obvious causes of evolution before appealing to the more abscure and doubtful.

It is possible that general movements affecting alike all classes may be accounted for in this way alone. But there are many facts in the evolution of the organic kingdom, especially the sudden appearance of new forms in the quietest times, which can hardly be thus explained. There seem to be *internal* as well as *external* factors of evolution. Again, the internal factors may be either in the form of *tendencies* to change or of *resistance* to change. Of these, however, the latter seems to be most certain. There may be in the organic kingdom an "*inherent tendency*" to change in special directions, similar to that which directs the course of embryonic evolution,—a tendency, in the case of the organic kingdom, inherited from physical nature from which it sprang, as in the case of the embryo it is inherited from the organic kingdom through the line of ancestry. This cause, however, is too obscure, and I therefore pass it by.

But whether or not there be any such inherent tendency to change, there certainly is an inherent tendency to *stability*,—to persistence of organic form. If there be no inherent force of progress, there certainly is an inherent force of *conservation* greater in some species than in others. It seems probable that in many of the more rigid types this stability is so great, and therefore variation of offspring so slight, that progressive change of form is too slow to keep pace with change of external conditions, especially in critical periods. If this be so, then an organism may be regarded as under the influence of two opposing forces: the one conservative, the other progressive; the one tending to equilibrium, the other to motion; the one to permanence, the other to change of form; the one static, the other dynamic; the one internal, *the law of heredity*, the other external, *the pressure of a changing environment.* Under the influence of two such forces, the one urging, the other resisting, it is evident that even with steady changes of external conditions the change of organic forms would be more or less paroxysmal. Other kinds of evolution, physical and social, evidently advance paroxysmally from this cause. As, therefore, in the gradual evolution of earth-features there are periods of comparative quiet, during which the forces of change are gathering strength but produce little visible effect, being resisted by crust-rigidity, and periods when the accumulating forces finally overcome resistance and determine comparatively rapid changes; as in social evolution there are periods in which forces of social change are gathering strength but make no visible sign, being resisted by social conservatism,—rigidity of the social crust,—and periods in which resistance gives way and rapid changes occur, so also in the evolution of the organic kingdom the forces of change, that is, pressure of changing environment, may accumulate but make little impression, being resisted by the *law of heredity*—of *like producing like*—or type-rigidity, until, finally, the resistance giving way, the organic form breaks into fantastic *sports* which are at once seized by natural selection, and rapid change is the result.

Some persons seem to think that paroxysmal evolution is inconsistent with the uniformity of nature's laws. On the contrary, it is in perfect accord.

Laws and forces are indeed uniform, but phenomena are nearly always paroxysmal. The forces of volcanoes and earthquakes, of lightning and tempest, are uniform, but the phenomena are paroxysmal. Winds at the earth's surface, where the resistance is great, *blow in puffs.* A thin sheet of water over a smooth sloping surface *runs in waves.* The law may be illustrated a thousand ways. In all cases where an accumulating force is opposed by a constant resistance, we have phenomena in paroxysms.

But whatever be the cause, the *fact* of paroxysmal movement of organic evolution is undoubted. All along the course of geological history, from beginning to end, even when the times were quietest, where the record is fullest and apparently without any missing leaf, species come and go and others take their place, and yet only rarely do we find any transition steps. If this were merely once or twice or thrice, or to any extent exceptional, it might be explained by loss of record here and there, but it occurs thousands and tens of thousands of times. Now, if evolution moves only at uniform rate, if it takes one hundred thousand years to transmute one species into another (as it certainly does when evolution is moving at its usual rate), if there are at least one hundred thousands steps (represented each, of course, by a whole generation of many individuals) between every two consecutive species, it is simply incredible that all the individuals representing the intermediate steps, so infinitely more numerous than the species they connect, should be so generally, almost universally, lost. But the phenomena, as we find them, are easily understood if a few generations represent the transition step, and many generations the permanent form.

A similar rapid, almost sudden, appearance and extinction of *genera, families,* and higher groups at certain horizons, are also common. In these cases the intermediate steps of transition are often found, and constitute, in fact, the chief demonstrative evidence of the truth of evolution. But the difficulty on the assumption of a uniform rate of evolution is none the less here, for the time required to evolve a new genus or a new family is, of course, immensely greater than in the case of a new species.

We will illustrate the difficulties of the ordinary view by one striking example. In the Upper Silurian, in the midst of a conformable series,—where if there be any break, any lost record, surely it must be very small, —appear suddenly, without premonition, *fishes;* not a connecting link between fishes and any form of invertebrates, but perfect, unmistakable fishes. Here we have, therefore, the appearance not only of a new class, but of a new sub-kingdom or type of structure, *Vertebrata.* Now, to change from any previously existing form of invertebrate, whether worm, crustacean, or mollusk, into a vertebrate, by a series of imperceptible steps represented by successive generations,—steps so imperceptible that it would take one hundred thousand of them to advance from one intermediate species to an other,—would require an amount of time which is inconceivable to the human mind, and a number of steps, each be it remembered, represented by thousands of individuals, which can scarcely be expressed by figures. And yet we must believe that these innumerable transitional forms, each represented by innumerable individuals, are all lost, and that this prodigious time shows no evidence in the rocky record. If this case were exceptional we might possibly admit that fishes appeared in Great Britain by migration (as they probably did), but only after having previously existed untold millions of ages somewhere else; but similar cases are too common to be explained in this way.

Now the whole difficulty disappears,—we avoid the incredible imperfection of the geological record (imperfect at best); we avoid also the necessity of extending geological time to a degree which cannot be accepted by the physicist,—if we admit that the derivation of one species from another is not necessarily by innumerable imperceptible steps, but may sometimes be by a *few decided steps;* and that the same is true for the origin of new genera, families, orders, etc.; in a word, that there are in the history of evolution of species genera, families, orders, etc., and of the organic kingdom *periods of rapid movement.* When the whole organic kingdom is involved in the movement, then we call the period *critical*, and the record of it is often lost.

Thus, on the supposition of such rigidity or resistance to change in organic forms, varying in degree in different species and in different genera, families, orders, etc., a rigidity, also, increasing by accumulated heredity so long as conditions remain unchanged, it is evident that, in times of perfect tranquillity all species grow more and more rigid. In times of very gradual change the more plastic species change gradually *pari passu*, while the more rigid species change paroxysmally, now one, now another, as their resistance is overcome. Finally, in times of revolution nearly all forms yield to the pressure of external conditions and change rapidly, only the very exceptionally rigid being able to pass over the interval to the next period of readjusted equilibrium.

Thus, for example, the great and wide-spread changes of physical geography which occurred at the end of the Carboniferous, appropriately called in this country the *Appalachian revolution*, were the death-sentence of the long continuing and therefore rigid Palæozoic types. But the sentence was not immediately executed. The Permian represents the time between the sentence and the execution,—the time during which the more rigid Palæozoic forms continue to linger out a painful existence in spite of changed and still changing conditions. But the most critical time—the time of the most rapid change, the time of actual execution—was the *lost interval.* Only a very few most rigid forms pass over this interval into the Trias.

The Quaternary, a Critical Period. We have given examples of several general unconformities, the signs of wide-spread oscillations of the earth-crust, attended with increase and decrease of land, and therefore with great and wide-spread changes of climate and other physical conditions, and also with great and rapid changes of organic species. These times of general oscillation are therefore the natural boundaries of the Eras or primary divisions of time. We have called them critical periods, transition periods,

periods of revolution, because they are times of rapid change, both in the physical and organic world,—a change overthrowing an *old* and establishing a *new* order of things. They are also times of *lost record.* We have seen that these critical periods, in comparison with the preceding and succeeding, are *continental periods*, and it is for this reason that their record is usually lost.

Now, the Quaternary is such a critical or transition period, marking the boundary between two great eras. The Quaternary is also a period of great and wide spread oscillations, with increase and decrease of land,—a period of upheaval, erosion, down-sinking, to rise again slowly to the present condition. The early Quaternary was therefore, to a marked degree a continental period. Here also we have newer rocks lying unconformably on the eroded edges of an older series—river sediments in old river-valleys, marine sediments in fiords; in other words, we have unconformity on a grand scale. Also, in connection with these oscillations, we have great changes in physical geography, and corresponding and very wide-spread changes in climate, and consequently corresponding rapid changes in organic forms. Here, then, we have all the characteristics of one of the boundaries between the primary divisions of time. We have a transition or *critical* period,—a period corresponding to one of the lost intervals; only in this instance, being so recent and being also less violent than the preceding ones, it is not lost. From this it follows that the study of the Quaternary ought to furnish the key which will unlock many of the mysteries which now trouble us. Some of the problems which have been or will be explained by study of the Quaternary we will now briefly mention.

I. *Changes of Species not sudden.* If the Quaternary were lost, and we compare the Tertiary rocks with the unconformably overlying recent rocks, and the Tertiary mammals with those now living, how great and apparently sudden seems the change! How like to a violent extermination and re-creation! But the Quaternary is fortunately not lost, and we see that there has been no such wholesale extermination and re-creation, but only gradual though comparatively rapid transition.

II. *Migration One Chief Cause of Change.* But what is sitll more important, we are able to trace with something like certainty the cause of these rapid changes, and we find that in the higher animals, chief among these causes have been *migrations*,—migrations enforced by changes of climate, and migrations permitted by changes of physical geography opening gateways between regions previously separated by impassable barriers. This point is so important that we must dwell upon it. Only an outline, however, of some of these migrations and their effects on evolution can be given in the present condition of knowledge.

During Miocene times, as is well known, evergreens, allied to those now inhabiting Southern Europe, covered the whole of Europe as far north as Lapland and Spitzbergen. In America, Magnolias, Taxodiums, Libocedrus, and Sequoias very similar to, if not identical with, those now living on the

Southern Atlantic and Gulf coasts and in California were abundant in Greenland. Evidently there could have been no *Polar ice-cap* at that time, and consequently no arctic species unless on mountain tops. During the latter part of the Pliocene the temperature did not differ much from the present; the Polar ice-cap had therefore commenced to form, with its accompaniment of arctic species. With the coming on of the *Glacial epoch*, the polar ice and arctic conditions crept slowly southward, pushing arctic species to Middle Europe and Middle United States, and sub-arctic species to the shores of the Mediterranean and the Gulf. With the return of more genial climate, arctic conditions went slowly northward again, and with them went arctic species slowly migrating, generation after generation, to their present arctic home.

Similarly, molluscous shells migrated slowly southward and again northward to their present position. But *plants* and some terrestrial invertebrates, such as insects, had an alternative which shells had not, namely, that of seeking arctic conditions also *upward* on the tops of mountains. Many did so, and were left stranded there until now. It is in this way that we account for the otherwise inexplicable fact that Alpine species in Middle Europe are similar or even largely identical with those in the United States, and also with those now living in arctic regions. These species were wide-spread all over Europe and the United States in Glacial times; and while some of them afterward went northward to their present home, some in each country sought arctic conditions in Alpine isolation. This explanation, which has been long recognized for plants, has been recently applied by Mr. Grote to arctic insects found on the top of Mt. Washington and the mountains of Colorado.*

Undoubtedly changes of climate during this time enforced similar migrations among mammals also. But it is evident that while plants and invertebrates might endure such modifications of climate and such enforced migrations with little alteration of form, the more highly organized and sensitive mammalian species must be either destroyed or else must undergo more profound changes. Moreover, the opening of land connections between regions previously isolated by barriers would be far more quickly taken advantage of by mammals than by invertebrates and plants. The migrations of plants are of necessity very slow, that is, from generation to generation. The migrations of mammals, too, so far as they are *enforced* by changing climate, are of a similar kind; but the voluntary migrations of mammals, *permitted* by removal of barriers, may take place much more rapidly, even in a few generations. This introduces another element of very rapid local change, namely, the *invasion* of one fauna by another equally well adapted to the environment, and the struggle for life between the invaders and the autochthones.

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* This application, with reference to Mt. Washington and other arctic insects in America, was previously made by Prof. A. S. Packard, Jr., in the Memoirs of the Boston Soc. Nat. Hist., i. p. 256. 1867.—Ed. American Naturalist.

For example: in America during the Glacial epoch, coincidently with the rigorous climate, there was an elevation of the continent, greatest in region of high latitude, but also probably great along the line of the Mississippi River; for in this region it extended southward even to and beyond the shores of the Gulf. Prof. Hilgard has shown that the elevation at the mouth of the Mississippi River was at least four hundred and fifty to five hundred feet above the present condition. Until the Glacial times the two Americas were certainly separated by sea in the region of the Isthmus, as shown by the Tertiary deposits there. This barrier was removed by upheaval during the Glacial epoch, and a far broader connection existed *then* than now. Through this open gate-way came the fauna of South America, especially the great Edentates, into North America. Similarly a broad connection then existed between America and Asia in the regions of the shallow sea between the Aleutian Isles and Behring Strait. Through this gate-way came an invasion from Asia, including probably the mammoth. With this invasion probably came also man. It seems probable, therefore, that the earliest remains of man in America will be found on the Pacific coast.

Also the great Pliocene lake, which stretched from near the shores of the Gulf far into British America, and possibly into arctic regions, and formed a more or less complete barrier to the mammalian fauna east and west *was abolished* by upheaval, and free communication was established. It is impossible that all these changes of climate and all these migrations partly enforced by changes of climate and partly permitted by removal of barriers, and in this latter case especially attended with the fiercest struggle for life, should not produce rapid and profound changes in the mammalian fauna.

In Europe the process has been more accurately studied and is better known. In Quaternary times at least four different mammalian faunæ struggled for mastery of European soil. (1.) The Pliocene autochthones. (2.) Invasions from Africa by opening of gate-ways through the Mediterranean: one by way of Italy, Sicily, and Malta and one by Gibraltar, both of which have been again closed. (3.) Invasions from Asia, by removal of a great sea barrier connecting the Black and Caspian seas with the Arctic Ocean. This gate-way has remained open ever since. (4.) Invasions from arctic regions, enforced by changes of climate. Probably more than one such invasion took place; certainly, one occurred during the second Glacial epoch. The final result of all these climatic changes and these struggles for mastery was that the Pliocene autochthones, adapted to a more genial climate, were mostly destroyed or else driven southward with some change into Africa: the African invaders were driven back also into Africa, and with some Pliocene autocthones isolated there by subsidence in the Mediterranean region closing the southern gate-ways, and still exist there under slightly modified forms; the Arctic invaders were again driven northward by return of more genial climate, and there exist to this day; while the Asiatics remain masters of the field, though greatly modified by the conflict.

Or perhaps, more accurately, we might say that the existing European mammalian fauna is a resultant of all these factors, but the controlling factor is the Asiatic. With the Asiatic invasion came man, and was a prime agent in determining the final result.

Thus, regarding the Tertiary and the Present as consecutive eras, and the Quaternary as the transition or critical period between, then, if the record of this period had been lost, corresponding with the unconformity here found, we should have had here an enormous and apparently sudden change of mammalian species. Yet this change of fauna, as great as it is, is not to be compared with that which occurred between the Archæan and Palæozoic, or between the Palæozoic and Mesozoic, or even that between the Mesozoic and Cænozoic; for the change during the Quaternary is mostly confined to species of the higher mammals, while the change during previous critical periods extended to species of all grades, and not only to species, but to genera, families, and even orders. We conclude, therefore, that the previous critical periods or lost interrals were far longer than the whole Quaternary; or else that the rate of evolution was far more rapid in these earlier times.

To sum up, then, in a few words, the general formal laws of evolution-change throughout the whole history of the earth :—

(1.) Gradual, very slow changes of form everywhere under the influence of all the factors of change, known and unknown: for example, pressure of changing physical conditions whether modifying the individual (certainly one factor), or selecting the fittest offspring (certainly another factor); improvement of organs by use and the improvement inherited (certainly a third factor), and perhaps still other factors yet unknown. This general evolution by itself considered would produce similar changes everywhere, and therefore would produce geological faunæ, but not geographical diversity. Determination of a geological horizon would in this case be easy, because fossil species would be everywhere identical.

(2.) Changes in different places and under different physical conditions, taking different directions and advancing at different rates, give rise to *geographical faunæ.* This, if there were nothing more, would produce far greater geographical diversity and more complete localization of faunæ and floræ than now exist,—so great that the determination of a geological horizon would be impossible.

(3.) The force of change resisted by heredity, in some species and genera more than in others, determines paroxysms of more rapid movement of general evolution, affecting sometimes species, sometimes genera or families. The sudden appearance of species, genera, families, etc., in quiet times is thus accounted for.

(4.) *During critical periods*, oscillations of the crust, with rapid changes of physical geography and climate, determine a more rapid rate of change in all forms; first, by *greater pressure of physical conditions;* and, second, by *migrations* partly enforced by the changes of climate and partly permitted by removal of barriers, and the consequent *invasion* of one fauna and flora by another and *severe struggle* for mastery. This would tend to *equalize again* the extreme diversity caused by the second law; but the effect would be more marked in the case of the animals than plants, because voluntary migrations are possible only in this kingdom. Hence it follows that a geological horizon is far better determined by the fauna than by the flora.

III. *Historic value of the Present Time.* Most geologists regard the Present as one of the minor subdivisions of the Cænozoic era, or even of the Quaternary period. More commonly the Quaternary and Present are united as one age—the age of man—of the Cænozoic era. The Cænozoic is thus divided into two ages: the age of mammals commencing with the Tertiary, and the age of man commencing with the Quaternary; and the Quaternary subdivided into several epochs, the last of which is the Present or Recent. But if the views above expressed in regard to critical periods be correct, then the present ought not to be connected with the Quaternary as one age, nor even with the Cæonozic as one era, but is itself justly entitled to rank as one of the *primary divisions* of time, as one of the great eras separated like all the other eras by a critical period; less distinct it may be, at least as yet, in species than the others, the inaugurating change less profound, the interval less long, but dignified by the appearance of man as the dominant agent of change, and therefore well entitled to the name *Psychozoic* sometimes given it. The geological importance of the appearance of man is not due only or chiefly to his transcendent dignity, but to his importance as an agent which has already very greatly, and must hereafter still more profoundly modify the whole fauna and flora of the earth. It is true that man first appeared in the Quaternary, but he had not yet established his supremacy; he was still fighting for mastery. With the establishment of his supremacy the reign of man commenced. An age is properly characterized by the *culmination*, not the first apperance, of a dominant class. As fishes existed before the age of fishes, reptiles before the age of reptiles, and mammals before the age of mammals, so man also appeared before the age of man.

We therefore regard the Cænozoic and Psychozoic as two consecutive eras, and the Quaternary as the critical, the revolutionary, or transitional period between. But since the record of this last critical period is not lost, and we must place it somewhere, it seems best to place it with the Cænozoic era and the mammalian age, and to commence the Psychozoic era and age of man with the completed supremacy of man, that is, with the Present epoch.

Berkeley, California, March 15, 1877.

ARCHÆOLOGY.

THE MOUND BUILDERS IN MISSOURI.*

BY H. N. RUST, CHICAGO.

The wide extent of country in which the mound-builders' relics of Missouri have been found forbid detailed account of each locality. The principal discoveries have been made in Scott and Mississippi counties, and within about twenty miles of Charleston. The first considerable discovery was early last season, in a dense cypress swamp known as Northcot's swamp, six miles west of Charleston. It is a part of that low country lying between Cape Girardeau and New Madrid, and which was partly submerged by the earthquake of 1811. The swamp is from one to one and one-half miles wide and covered with a heavy growth of timber, mostly cypress. There are patches of sandy land in this swamp upon which I am told there are many mounds, some of which are fifty feet high; but it is very difficult to reach them except when the swamp is frozen.

I have never seen a more undesirable place occupied by mankind. On one of the tracts of sand land we found a cleared field of about 40 acres. This field is partly surrounded by a ditch 12 to 18 inches deep, the earth which was thrown out of it forming a corresponding embankment. Within this area are two large mounds, the one a truncated pyramid, about fifteen feet high and 75 feet in its longest diameter. This was cleared of timber about forty years ago, and having been ploughed and cultivated since, has been much reduced in its height and shape. On this mound we found beds of ashes, a few flint chips and arrow heads and many fragments of pottery. Seventy-five feet westerly from this mound is a large grave; 100 feet easterly was found still another, both in the level plain. About 75 feet south of this mound is a small pond of water, perhaps 60 feet in diameter and very near circular in form. Here, I imagine the earth was taken out to build the next mound, which is sixty feet southeast of the pond, and is conical in form, 15 feet high and about 40 feet in diameter.

An examination of both these mounds failed to discover any thing of interest. Upon the last mentioned mound stands an oak tree which measured 3½ feet in diameter. This and other trees of corresponding size standing upon the graves in the level plain are the most positive evidences I could gather of the antiquity of these graves. About 50 feet east of the last mentioned mound in the level plain was discovered the first grave in this field. Here within a circle, the diameter of which is 75 feet, was found several hundred skeletons and a great variety of pottery, with comparatively few stone implements.

* Read before the American Association for the Advancement of Science, Sept. 4, 1877.

Quite near this grave and a little south are a series of depressions and hillocks, five or six each in continuous line, alternating as if the earth from each depression formed the next hillock.

These are ten to twelve feet in diameter and in the center, being the lowest point, about eighteen inches deep. These were not noticeable upon my first visit, but the timber having been cleared off last winter, they can now be plainly seen.

The surface has been recently ploughed, but I was unable to discover any indications here more than elsewhere that they had been the site of human habitations.

A few rods south within the timber another large grave was found, and about one-eighth of an acre has been dug over, and large trees undermined and thrown down to secure the pottery which was buried here long years before these trees had life.

A few isolated graves, where from one to six bodies were deposited, have been found in the field, but the four mentioned are the principal ones discovered in this vicinity, and each contained several hundred bodies.

A general description of the forms of burial and deposit may be applied to all the graves I have seen in Missouri. The largest deposits have been found rather in the level plain or in elevations varying from 18 inches to 4 feet high (with one exception.) In many instances the elevation is so slight and irregular as scarcely to be noticed. The graves were found to be from 18 inches to 4 feet deep. In all instances the bodies were buried in a horizontal position, but in nothing like regular order. Sometimes in going down 4 feet we would find 4 to 5 skeletons at different levels, and all lying in different directions. The bones were generally so much decomposed that they could be saved only by the greatest care. Sometimes we could not lift them before they would crumble to dust. Some were so far decomposed that only a colored line in the earth was distinguishable. Yet the pottery which was almost invariably deposited near the head of each individual remained complete. I was able to preserve a few skulls in a very good state of preservation by carefully drying them in the sun immediately after taking them from the earth and later dipping them in a solution of common glue. These are widely different in form, but the most noticeable irregularity is a depression upon the back side, sometimes from left to right, sometimes in the opposite direction. My first impression was that this flattening process was during lifetime, but upon a more extended observation I came to believe it was done by the weight of the earth, when the bone was softened by long continued moisture.

Two days ago I opened several of the stone graves in this vicinity and noticed the same depression in each instance, the principal difference here being that the depression was greater and in some instances the skull was entirely crushed. Here the earth is less yielding than the sandy soil of Missouri and in some instances these stone graves have a stone floor—I imagine that certain conditions of the soil were better calculated to preserve both bone and pottery than others, as we found that the dry sandy soil furnished better preserved bones and pottery than that which was found where the earth was more moist and heavier. We saw no marks of violence upon the bones such as would indicate a violent death. As before remarked, we found that in nearly every instance from one to three articles of pottery were deposited near the head of each individual. The most common form of which is the jug or water cooler. Next, the open dishes without ornament or handle, a large proportion of which were broken when found, probably by action of frosts and weight of soil. The open dishes with four ears and a flaring rim, or with projections by which it might be suspended, are quite common. I saw only two attempts to make a square dish.

The most curious and interesting forms are the human representations, and by far the most rare. Rude and ugly as they are may they not represent the prehistoric ideal of beauty? I think we can see in some specimens a close resemblance to the ancient Peruvian pottery—a similar style of head-dress is noticeable, and the humpback is very common. A few vessels are quite nicely ornamented in colors, some of which appear to have been laid on with a brush, and others are a mixture with the clay, sometimes several lines in thickness, and thoroughly baked with the vessel. All these colors are much more distinct after having been exposed to the sun than when taken from the earth.

The sun and moon are among the objects represented in colors. In some instances figures of the human head form the handles of open dishes and are nicely wrought in fine clay. In such the cavity of the head contains several little balls of clay, which make a noticeable rattle when the bowl is shaken.

We found a very good representation of a child's knit sock and the Indian moccasin, several varieties of fishes—in some specimens the scales are nicely shown. We have also the alligator, the turtle, frog and salt water clam; the opossum, the squirrel, fox, wolf, hog and beaver; the turkey, owl and duck, as well as the squash, gourd and melon. All these seem to have been favorite forms. The owl and ducks' heads often formed the handles of open dishes. All these have openings showing they were made for use. The majority will hold from one to three pints, a few large ones holding as many quarts, and some hold not more than one or two ounces. In several we found the bones of some of the small animals and fishes, and what appeared to be the remains of animal matter, which may have been deposited as food.

In some of these vessels were found small pebbles showing positive marks of having been used and evidently deposited with care, small plates of mica, very many muscle shells, and a very few beads of baked clay, others made of shells. Among the other articles found in the graves were stone spades from seven to thirteen inches long, chipped out and nicely polished by long use; the common form of spear-heads, arrow-heads and stone knives, celts and chisels, all nicely polished; pestles of pottery, which I judge were made to knead the clay and perhaps smoothe the surface of the pottery; several small cylindrical shaped articles, about one inch in length, which reminds us of a bottle stopper, and may have been worn in the ear or lip as ornaments. I have one made of shell, one of Fluor Spar, and several of pottery, all about the same size; smooth stones weighing from one to ten ounces are found bearing marks of long use; flat stones about the size of the palm of the hand with a depression on each side—may have been used in grinding colors, as small pieces of red Hematite were found with them; pieces of sandstone ground, showing they had been used as whetstones; several small discoidal stones from one to one and one-half inches in diameter, some of them entirely perforated in the center; other discordels or whorls and marbles, made of clay; a small mask of same material; a few large shells from the sea, having been cut in shape to form a convenient dipper.

We found only three pieces of native copper, two of which appeared to have been used as pendant ornaments, being in the form of the sunfish, about three inches in length. On a small disc of wood about one and a half inches in diameter, was found a very thin plate of copper. This was perforated at the center.

This was all the metal found. We found several pieces of galena which had the appearance of having been worn by constant use.

Several pieces of cannel coal, wrought in curious shapes, nicely polished, still retain their smooth surface. One of these, I believe, was worn as a lip ornament.

Nothing like grain or any woven fabrics have been found to my knowledge.

About two miles north of Charleston another grave was discovered early this summer. It was in an open plain occupied as an orchard. It had been cultivated many years and the burials were very near the surface.

Three miles east of Charleston on the Mississippi bottom, or overflow, is a mound about 100 feet long by 75 feet wide, 15 feet high. Long cultivation must have much reduced its original proportions. This is the only large burial mound, to my knowledge, in this vicinity. This one seemed to have been crowded full. Here the earth is quite moist, a very heavy adhesive mixture of clay and sand. Here the bones are not as well preserved and the pottery was softer and coarser, very easily broken, but great quantities have been buried here.

About 100 feet north is a similar shaped mound, about one-half the size of the one last mentioned. Upon this lay the remains of a fallen oak not less than 3 feet in diameter. We dug about 4 feet from this stump and about 2 feet below the surface, came to the charred remains of a post or stake about 4 inches in diameter. We uncovered it about 4 feet, finding a quantity of charred human bones, and below this for about 18 inches the stake was not charred, but decayed. Very little pottery was found in this mound.

South of Charleston was a large grave in a sandy loam. Here were four small mounds, quite near together, about 4 feet high, and all burial mounds except one.

Twelve miles further south, on James bayou, are two mounds, quite near the bayou, about 8 feet high and 40 feet in diameter. Neither seemed to be burial mounds; but near by in the same field was found a large grave in a slight elevation. It extended into the street, and was so slight that one in passing would hardly notice it above the usual level. Here were several hundred good vessels found in a space not larger than 30 by 60 feet. These finds constitute the greater part of all I have examined in Missouri. I very much regret that these works could not have been more carefully and intelligently opened; but since it has been done by private enterprise alone, and no one having entire control of the premises, we could do no better.

Much of value and interest has been forever lost. My endeavor has been to preserve all the facts which came to my knowledge, and I only regret that I could not have done the work more perfectly.

Examination of Indian Mounds on Rock River, at Sterling, Illinois. —I recently made an examination of a few of the many Indian mounds found on Rock River, about two miles above Sterling, Illinois. The first one opened was an oval mound about twenty feet long, twelve feet wide, and seven feet high. In the interior of this I found a *dolmen* or quadrilateral wall about ten feet long, four feet high, and four and a half feet wide. It had been built of lime-rock from a quarry near by, and was covered with large flat stones. No mortar or cement had been used. The whole structure rested on the surface of the natural soil, the interior of which had been scooped out to enlarge the chamber. Inside of the dolmen I found the partly decayed remains of eight human skeletons, two very large teeth of an unknown animal, two fossils, one of which is not found in this place, and a plummet. One of the long bones had been splintered; the fragments had united, but there remained large morbid growths of bone (exostosis) in several places. One of the skulls presented a circular opening about the size of a silver dime. This perforation had been made during life, for the edges had commenced to cicatrize.

I later examined three circular mounds, but in them I found no dolmens. The first mound contained three adult human skeletons, a few fragments of the skeleton of a child, the lower maxillary of which indicated it to be about six years old. I also found claws of some carnivorous animal. The surface of the soil had been scooped out, and the bodies laid in the excavation and covered with about one foot of earth; fires had then been made upon the grave, and the mound afterwards completed. The bones had not been charred. No charcoal was found among the bones, but occurred in abundance in a stratum about one foot above them. Two other mounds examined at the same time contained no remains.

Of two other mounds opened later, the first was circular, about four feet high, and fifteen feet diameter at the base, and was situated on an elevated point of land close to the bank of the river. From the top of this mound one might view the country for many miles in almost any direction. On its summit was an oval altar, six feet long and four and one-half wide. It was composed of flat pieces of limestone, which had been burned red, some portions having been almost converted into lime. On and about this altar I found abundance of charcoal. At the sides of the altar were fragments of human bones, some of which had been charred. It was covered by a natural growth of vegetable mold and sod, the thickness of which was about ten inches. Large trees had once grown in this vegetable mold, but their stumps were so decayed I could not tell to what species they belonged. Another large mound was opened which contained nothing.—W. C. Holbrook, in *American Naturalist*.

Mound Builders of Illinois.—The Chicago *Inter-Ocean* has a letter from a correspondent at Rockford, Illinois, who, under date of August 27, "The Rockford Scientific Society made an excursion last Friday to investigate the mounds which are so numerous along the banks of the Rock River. The spot chosen was about seven miles south of this city, on the river. Two mounds were opened. In the first, at a depth of five feet from the top of the mound, and about a foot below the surface of the surrounding country, detached pieces of bone were discovered, and with great care the perfect reclining form of a skeleton was excavated. The body at burial had been laid on the right side facing the sun, with legs drawn up and knees to the chin, with hands crossed in front. The skull was taken out and brought to this city, where it will be carefully examined. The teeth are in a wonderful state of preservation. It was impossible to remove the skeleton whole from its long resting place, it being as soft and frail as the mould which encased it, and only detached pieces could be secured. It is the first specimen which the society has secured of the genuine pre-historic mound builder, and that it belongs to that long extinct and mysterious race of people they have no doubt. The society also commenced the opening of a larger mound near by, but were unable to finish it. A number of large stones were found near the centre of this mound. Some of the stones were foreign to this locality and State, and were undoubtedly brought from the Lake Superior region, and for what purpose they were placed there it is not possible to conjecture until the mound is more fully opened. The society propose to continue their interesting discoveries and I will attend their investigations. Near this locality, a few days since, a party of laborers recently exhumed with a plow several skeletons which were lying near the surface, and which, from chronological appearances as well as from the fact that they were buried near the surface, were undoubtedly Indians. With these skeletons was found a pebble stone pipe of unusual polish and finish; also three hollow deers' leg bones, which had evidently been used as musical instruments of some kind, and which were perforated at regular intervals with round and square holes."

MEDICINE AND HYGIENE.

Experiments on the Effects upon Respiration of cutting off the Supply of Blood from the Brain and Medulla Oblongata.

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In October, 1861, I published in the *American Journal of the Medical Sciences* a paper on "Points connected with the Action of the Heart and with Respiration." In this paper, I contended that the respiratory sense (*besoin de respirer* of the French), or sense of want of air, which gives rise to the movements of respiration, is due to a want of oxygen in the general system. I assumed that the medulla oblongata is the center presiding over the respiratory movements; that these movements are reflex; that a certain sense, called the respiratory sense, is conveyed to the medulla oblongata; and that it is this sense which is the starting-point of the respiratory acts. I showed that a dog brought under the influence of ether, with the heart and lungs exposed and with a bellows in the trachea, will make no respiratory efforts so long as air is efficiently supplied to the lungs by artificial respiration, an experiment essentially the same as one made by Robert Hook, in 1664. In an animal in this condition, I showed that respiratory efforts were made, when artificial respiration was interrupted, as soon as the blood became dark in the arteries, having opened an artery and noted the color of the blood as the experiment progressed.

It seemed to me at that time that the sense of want of air in this experiment was due to the properties of the dark-colored blood circulating in the arterial system; and the question arose in my mind whether this were dependent upon the deficiency of oxygen in the blood or upon the presence of carbonic acid. In order to answer this question, I drained an animal (a good-sized dog) of blood by dividing the femoral artery, the chest having been opened with the animal under the influence of ether, and artificial respiration being maintained in the usual way. In this experiment, although the lungs were constantly supplied with air, violent respiratory efforts were made as the animal became nearly exsanguine.

In another experiment, I divided both pneumogastric nerves and ascertained that there was no difference in the phenomena observed, showing that these nerves are not the sole conductors of the sense of want of air, if, indeed, they have any part in this function. In still another experiment, I drained an animal of blood by cutting out the heart. This was followed by violent respiratory efforts, showing that the sense of want of air has nothing to do with distension of the right cardiac cavities.

From the experiments of which I have thus given a brief sketch, made in 1861, I concluded that the sense of want of air, or the respiratory sense, was due to a want of oxygen in the general system, producing an impression which was conveyed to the medulla oblongata and which gave rise to respiratory efforts; that, in ordinary respiration, this reflex action took place unconsciously, but became exaggerated when there was a great deficiency of oxygen, and was then experienced as a sense of suffocation; that the respiratory sense thus had its origin in the general system and had nothing to do with the lungs, as the sense of thirst has its seat in the general system, from deficiency of water, and has simply a local manifestation in dryness of the throat and fauces. In addition to the experimental arguments in favor of this view, I saw, in cases of distress in breathing from deficient circulation, as in certain cases of disease of the heart in which the lungs are normal, what seemed to me to be a confirmation of my opinion.

The views which I have just stated were advanced by me in my work, "Physiology of Man," New York, 1866, vol. i., page 479, *et seq.*, and in my "Text-Book of Human Physiology," New York, 1876, page 164, *et seq.* In February, 1874, I made an address before the New York Society of Neurology and Electrology upon the "Mechanism of Reflex Nervous Action in Normal Respiration," an abstract of which was published in the *New York Medical Journal*, in April of the same year. The full text of this address was published in the *Chicago Journal of Nervous and Mental Diseases*, in April, 1874. In this, I still adhered to my original view, and I extended my reflections to the theory of the cause of the first respiration at birth, respiration by means of the placenta *in utero*, etc.

At the present day nearly all physiological writers agree that the sense of want of air is due to want of oxygen, and not to any stimulating or irritating properties of carbonic acid; and this idea has received complete confirmation from the experiments of Pflüger upon the effects of respiration of nitrogen, as is seen by the following extract:

"Using blood-letting for ascertaining the condition of the blood during dyspnœa, I arrived at the following facts: As soon as the dog begins to breathe pure nitrogen, it is scarcely fifteen seconds before he makes violent and deep inspirations; at the end of thirty seconds, the most intense dyspnœa is observed, the blood is already almost absolutely black, which must be due to the enormously-rapid tissue-metamorphosis of this animal."*

It is seen that this experiment, made in 1868, is almost identical in idea and results with those which I made in 1861, except that Pflüger made his animal breathe a gas not capable of supporting respiration, while I simply deprived animals of air. Nearly the same experiment as that performed by Pflüger was made by Rosenthal, in 1862, who noted that animals suffered no dyspnœa when air or oxygen was forced through the lungs, but that dyspnœa was manifested when nitrogen or hydrogen was used instead of oxygen.†

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* Pfluger, "Ueber die Ursache der Athembewegungen, sowie der Dyspnœ und Apnœ."—*Archiv fur die gesammte Physiologie*, Bonn, 1868, Bd. i., S. 89.

† Rosenthla, "Athembewegungen," etc., Berlin, 1862, S. 4.

While physiologists are now pretty generally agreed that the sense of want of air is connected with a deficiency of oxygen in the blood of the arteries, some writers are of the opinion that the "sense" is primarily due to a want of oxygenated blood circulating in the medulla oblongata. This opinion has been advanced by some authors, but, as far as I know, it rests mainly upon theory, and has no positive experimental foundation. Since I made the experiments which form the basis of this article, I have consulted a number of systematic works upon physiology, with reference to the subject under consideration. Most of the works examined contain no very definite allusions to the respiratory sense, or at most only brief and unsatisfactory statements: but, in two, I find the following references, which are directly pertinent to the question:

"The first respiratory effort of the fœtus is thus produced by the interruption of the placental respiration, the sudden deficiency of the oxygen and increase of carbonic acid in the blood (Schwartz). This change in the blood needs to take place locally only in the vessels of the medulla oblongata, in order to produce this effect; it occurs, for example, from arrest of the blood in these vessels (by ligature of the carotid arteries, Kussmaul and Tenner, Rosenthal, or by closure of the venous currents from the brain, Hermann and Escher), by which their blood becomes progressively poorer in oxygen and richer in carbonic acid" (Hermann, "Grundiss der Physiologie des Menschen," Berlin, 1870, S. 160).

"If the supply of blood be cut off from the medulla by ligature of the blood-vessels of the neck, dyspnœa is produced, though the operation produces no change in the blood generally, but simply affects the respiratory condition of the medulla itself, by cutting off its blood-supply, the immediate result of which is an accumulation of carbonic acid and a paucity of available oxygen in the protoplasm of the nerve-cells in that region" (Foster, "A Text-Book of Physiology," London, 1877, p. 254).

These quotations from Hermann and from Foster show clearly that their idea is, that the sense of want of air is due to deficiency of oxygenated blood in the medulla oblongata, a view fully sustained by my own experiments. The observations of Kussmaul and Tenner, referred to by Hermann, were made with reference to the cause of the convulsions which so often occur after profuse and sudden hæmorrage. They are to be found in the elaborate memoir by Kussmaul and Tenner, "On the Nature and Origin of Epileptiform Convulsions, caused by Profuse Bleeding," translated and published by the "New Sydenham Society," in 1859. Kussmaul and Tenner made a large number of experiments upon rabbits and horses, in which they observed the effects of tying the great vessels given off from the arch of the aorta. They noted, after this operation, great difficulty in respiration and violent convulsions. They did not, however, abolish the respiratory movements of the animal by artificial respiration, thus abolishing, for the time, the respiratory sense, and then note the effect of ligature of these vessels. The experiments by Rosenthal, which are referred to, are probably those contained in his work on "Die Athembewegungen und ihre Beziehungen zum Nervus Vagus," Berlin, 1862. In these experiments, as I have already stated, it is shown that the respiratory efforts of an animal can be abolished by forcing atmospheric air or oxygen in large quantities through the lungs, but that the sense of want of air is felt when, in place of oxygen, nitrogen or hydrogen is employed, by this means removing the possibility of an irritation from carbonic acid. These are essentially the same as the observations made by Pflüger, in 1868. Rosenthal states very distinctly that the sense of want of air is due to want of oxygen-carrying blood in the medulla oblongata; but he does not actually demonstrate the truth of this proposition by experiments. The statements by Hermann and by Foster are apparently based upon the experiments of Kussmaul and Tenner and of Rosenthal; but I must nevertheless claim that the experiments which I have made upon this subject, which will be detailed farther on, if they should be confirmed, afford the first positive proof that the respiratory sense may be excited by cutting off the arterial supply from the medulla. There is nothing which I can find, in the experiments of Kussmaul and Tenner or of Rosenthal, to actually show that the sense of want of air is not due to a want of oxygen in the general system.

In reflecting upon this subject during the last few months, it occurred to my mind that the the question was capable of a positive solution by experiment. If it be possible to cut off the arterial supply to the head and medulla oblongata, leaving the rest of the circulation free, an animal should make respiratory efforts, even though air be supplied to the lungs, provided that the sense of want of air be due to a want of oxygenated blood in the medulla. On the other hand, if the sense of want of air be due to a want of oxygen in the general system, cutting off the arterial supply from the head and medulla would have no more effect than cutting off the supply of oxygen from any other equally extensive part of the system. In reducing this idea to the project of an actual experiment, I conceived the following: I proposed to tie all the vessels that could by any means supply the medulla oblongata with blood (the vessels given off from the arch of the aorta), and note the effects; and then to tie the descending aorta in the chest, and note the effects, leaving the vessels coming from the arch of the aorta free. It seemed to me that, if the respiratory sense were due to want of oxygen in the general system, tying the aorta in the chest would induce respiratory efforts certainly as promptly as cutting off the arterial supply from the medulla. With the view of settling this question, if possible, I made the following experiments, which, as far as they go, are exceedingly definite and satisfactory in their results. I propose, however, to extend these experiments, and I publish them now simply as preliminary to farther investigations into the subject under consideration:

Experiment I., *September* 30, 1877.—A medium-sized, full-grown dog was brought completely under the influence of ether. The trachea was then opened and connected with a bellows, and artificial respiration was maintained. Over the valve of the bellows was placed a sponge, which was saturated with ether from time to time, so that the animal was kept completely anæsthetized during the experiment. The air in the bellows was also changed from time to time by pushing up the valve with the fingers and forcing out the vitiated air. The chest and abdomen were then laid open by a continuous incision in the median line, and the ribs were bent backward and secured with a strong cord tied behind the back, so that the lungs and heart were fully exposed. The pericardium was then cut away, the great vessels near the heart were isolated, and loose ligatures were thrown around the trunk of the innominate artery, the left subclavian artery, the descending vena cava, the descending portion of the aorta, and the ascending vena cava.* In this way, I was prepared to constrict the several vessels at will.

When these preliminary steps had been completed, the animal being entirely under the influence of ether and artificial respiration being kept up efficiently, there were absolutely no respiratory efforts, and the diaphragm, which was exposed, was quiescent.

The artificial respiration was then arrested. In forty-five seconds, the animal began to make violent respiratory efforts. Artificial respiration was then resumed, and the respiratory efforts of the animal ceased. When the artificial respiration was arrested, we first noticed a movement of the corners of the mouth at regular intervals, and then the mouth was widely opened and the diaphragm became strongly contracted, also at regular intervals. The time was taken at the first violent respiratory effort.

The animal being perfectly quiet and making no efforts at respiration, the innominate artery, the left subclavian artery, and the descending vena cava, were tied nearly simultaneously, artificial respiration being constantly and efficiently maintained. In two minutes and eight seconds, the animal began to make respiratory efforts, which continued as long as the vessels remained constricted.

The ligatures surrounding the vessels mentioned above were loosened five minutes and twenty-two seconds after they had been tied, and the respiratory efforts of the animal instantly ceased. After three minutes, artificial respiration was stopped, and the animal began to make respiratory efforts in thirty-nine and a half seconds, which ceased as soon as artificial respiration was resumed.

The descending aorta and the ascending vena cava in the chest were then tied simultaneously, the vessels arising from the arch of the aorta being free. This seemed to produce no effect, and no respiratory efforts were made by the animal for five minutes. The innominate artery and the left subclavian artery were then constricted, the aorta and ascending vena cava remaining tied. Respiratory efforts by the animal began in one minute

*In the dog, the aorta gives off the innominate artery "which gives off first the left carotid, and then divides into the right subclavian and right carotid" (Foster, "Elementary Practical Physiology," London, 1876, p. 13). The left subclavian artery arises directly from the aorta.

and twenty-six seconds, although artificial respiration was maintained. These efforts ceased when the ligatures around the innominate and subclavian were loosened.

The ligatures were then removed from the descending aorta and ascending cava vena, and the innominate and left subclavian arteries were constricted, which was followed by respiratory efforts after one minute and six seconds. These efforts ceased when the vessels were freed.

The innominate artery alone was then constricted, but this seemed to produce no effect, no respiratory efforts being made by the animal for five minutes. At the end of five minutes, the left subclavian artery was constricted, the constriction of the innominate artery being maintained. The animal began to make respiratory efforts fifty-three seconds after constriction of the subclavian. These efforts ceased on loosening the ligatures.

Artificial respiration was then stopped, and the animal began to make respiratory efforts in ten seconds. The medulla oblongata was then broken up, and the experiment was concluded.

In this experiment I had the aid of my able assistant, Dr. C. F. Roberts, and of Mr. Gaspar Griswold, an advanced laboratory student. As the experiment progressed, it was ascertained that the vessels could be effectually constricted by making traction on the ligatures without tying. The constriction could then be instantly removed. It was also ascertained that constriction of the veins made no difference in the phenomena observed.

Experiment II., *October* 2, 1877.—A medium-sized, full-grown dog was brought completely under the influence of ether. A bellows was fixed in the trachea and the chest and abdomen were opened as in the preceding experiment. These preliminary steps were completed at 11.30 A. M. Artificial respiration, which had been kept up with the bellows, was arrested, and the animal made efforts at respiration in thirty-seven and three-fifths seconds, having previously been quiet. The innominate artery and the left subclavian artery were then constricted, the artificial respiration being continued, and the animal made respiratory efforts in two minutes and five seconds, having previously been rendered quiet by artificial respiration. After a few respiratory efforts, the ligatures were loosened, and the animal became perfectly quiet, artificial respiration being continued. While the animal was perfectly quiet, artificial respiration being continued, the descending aorta was tied in the chest. The aorta was constricted for five minutes, and no effect was observed, artificial respiration being maintained, and the animal remaining perfectly quiet. The heart was then cut out, the system being thus drained of blood, and the animal made respiratory efforts in twenty-five seconds.

This experiment was a public demonstration made in a lecture before the class at the Bellevue Hospital Medical College; and I was assisted by Dr. C. F. Roberts, Mr. Gaspar Griswold, Dr. G. S. Conant, and Mr. W. L. Wardwell. The experiment was essentially a repetition of Experiment I., and the results of the two observations were nearly identical.

The two experiments just detailed show that ligature of the aorta has no sensible effect upon respiration; but that ligature of all the vessels given off from the arch of the aorta, which, it would seem, must cut off the supply of oxygenated blood from the brain and the medulla oblongata, produces a sense of want of air, which gives rise to respiratory efforts, even while artificial respiration is efficiently maintained. It seems, from the results observed in Experiment I., that it is not enough to tie the innominate artery, which is equivalent to tying the two common carotids and the right subclavian artery, but that it is also necessary to tie the left subclavian artery. This is explained by the fact that the left subclavian gives off the vertebral artery, which empties into the basilar artery, and thus carries oxygenated blood to the medulla oblongata.

Taking into account the fact that the sole respiratory nervous centre is situated in the medulla oblongata, the two experiments which I have described, as far as they go, seem to show conclusively that the sense of want of air is due to a deficiency of oxygenated blood in the medulla oblongata, and that this sense is satisfied by the circulation of such blood in the respiratory nervous centre.

Experiment III., *October* 7, 1877.—A full-grown young dog, weighing about thirty pounds, was brought completely under the influence of ether at 10.45 A. M., a bellows was fixed in the trachea, and the chest and abdomen were opened as in the preceding experiments. The vessels given off from the arch of the aorta were then carefully dissected out, and loose ligatures were thrown around the innominate artery, the two carotids, the right subclavian artery, the right vertebral artery, the left subclavian artery, and the left vertebral artery. These ligatures were placed around the vessels so that they might be readily found in the course of the experiment, but the vessels were not thereby constricted.

After these preparatory steps had been completed, artificial respiration was arrested, and the animal began to make respiratory efforts in thirty seconds. Artificial respiration was then resumed, and the animal became quiet.

The two subclavian arteries were then constricted with *serre-fines*, which, it was ascertained, arrested the blood-current completely. The animal remained quiet for five minutes, making no respiratory efforts. The subclavians remaining constricted, both carotids were then constricted in addition. The animal made respiratory efforts in two minutes and seven seconds after constriction of the carotids. All the vessels were then freed, and the animal became quiet.

Both vertebral arteries and both carotids were then constricted for five minutes, the animal remaining quiet. These vessels remaining constricted, both subclavian arteries were constricted in addition. The animal made respiratory efforts in one minute and thirty-five seconds. All the vessels were then freed, and the animal became quiet.

At 11.40 o'clock, the descending aorta in the chest, and both subclavian arteries were tied. This left little more than the carotids to carry blood to the head, and the arterial blood was thus cut off from the greatest part of the system. The animal remained quiet for five minutes. The experiment had now lasted fifty-five minutes, and the action of the heart had become considerably weakened. While the aorta and subclavians were still constricted, both carotids were constricted in addition. The animal remained quiet for five minutes, but the heart and great vessels up to the points of constriction were enormously distended. At the end of this time, the aorta was freed, which relieved the distension. The animal made respiratory efforts in two minutes and twenty-nine seconds, but the efforts were not very violent and were not as rapid as usual. All the vessels were freed and the animal became quiet.

Artificial respiration was then arrested, and the animal made respiratory efforts in twelve seconds. Artificial respiration was resumed, and the animal became quiet.

The innominate artery and the left subclavian artery were then constricted, and the animal made respiratory efforts in one minute and fifteen seconds, but the action of the heart had become very feeble.

The experiment had lasted one hour and fifteen minutes, and was concluded with the last observation.

In this experiment, I was assisted by Dr. C. F. Roberts, Mr. Gaspar Griswold, and Dr. G. S. Conant.

This experiment substantially confirmed the results obtained in Experiments I. and II. When the aorta, both subclavian arteries, and both carotids, were constricted, the pressure of blood in these vessels was enormous, and some blood may have found its way to the brain and medulla oblongata. The distension of the vessels was so great that this part of the experiment was not very satisfactory. Respiratory efforts were made by the animal, however, when the distension was relieved by freeing the aorta, the subclavians and the carotids remaining constricted.

In all the experiments, the animals were kept completely under the influence of ether, and artificial respiration was kept up efficiently unless otherwise stated.

Deductions and Conclusions.—When I made my first experiments upon the location of the sense of want of air which gives rise to respiratory movements, in 1861, I attached to them considerable importance, and I thought that I had proved experimentally that the sense of want of air is due to a deficiency of oxygen in the system at large. The main features of the experiments which I made at that time I have already stated. My object in making these new experiments was to study the effects of cutting off the supply of oxygenated blood from different parts.

I think it can be assumed, as I have already stated, that the sole respiratory nervous centre is in the medulla oblongata, and I endeavored to devise some means of cutting off the arterial supply of blood from this part. Animals respire when all of the encephalic centres have been destroyed except the medulla oblongata, so that it is improbable that cutting off the supply of blood from the brain would affect the muscles of respiration, provided that artificial respiration be efficiently maintained. Blood can get to the medulla oblongata from the internal carotids, which are connected with the circle of Willis, from the vertebral arteries, which unite to form the basilar artery,* and perhaps from other vessels; but it is certain that, if all the arteries given off from the arch of the aorta be tied, the medulla oblongata must be deprived of oxygenated blood.

In Experiment I., the innominate artery and the left subclavian artery were constricted,† and the animal made respiratory efforts in two minutes and eight seconds, notwithstanding that artificial respiration was kept up.

In Experiment II., the same vessels were constricted, and the animal made respiratory efforts in two minutes and five seconds.

In Experiment III., both subclavian arteries and both carotids were constricted, and the animal made respiratory efforts in two minutes and seven seconds. Both vertebral arteries and both carotids were constricted, and the animal made no respiratory efforts for five minutes; but respiratory efforts were made in one minute and thirty-five seconds after both subclavians had been constricted in addition to the vertebrals and carotids.

It seems, from all of these experiments, that, in order to induce respiratory efforts in an animal under the influence of ether and with the lungs supplied with air by artificial respiration, either the innominate artery and the left subclavian artery, or both subclavians, both carotids, and both verbral arteries, must be tied. In other words, according to my views of the cause of these respiratory efforts, the supply of blood to the medulla oblongata cannot be cut off completely except by tying all the vessels given off from the arch of the aorta.

As the result of the experiments which I have just detailed, I must now modify the view which I advanced in 1861 as a conclusion from experiments then published, which I have maintained up to the present time, that the sense of want of air, which is the starting-point of the movements of respiration, is due to want of oxygen in the general system. My experiments made in 1861 were accurate, and the conclusions from them seemed to be legitimate; but these experiments were incomplete. The experiments which I have just reported, taken in connection with my experiments of 1861, lead me to conclude that the sense of want of air is due to a want of circulation of oxygenated blood in the medulla oblongata.

I trust that my experiments, which are by no means difficult, or uncertain in their results, may be repeated and verified or corrected, by other physiologists. The idea that the sense of want of air is due to a deficiency of oxygen in the medulla has been adopted by some writers; but, as far as

* The basilar artery is much longer in the dog than in the human subject.

† In the first experiment, the great veins were also tied, but this seemed to make no difference in the phenomena following constriction of the arteries, and the veins were left free in the other experiments.

I know, my experiments are the first to show, by actual demonstration, that this view is correct.

In another paper, I propose to treat of the respiratory sense much more fully, and to review the literature of the subject. Many interesting and important points will undoubtedly be involved in a full discussion of the nervous mechanism of the respiratory movements, and among them will be the question as to whether the normal respiratory movements be actually reflex in their character, as has been generally supposed, or whether they be due to a direct excitation of the nerve-cells in the respiratory centre.—*New York Medical Journal.*

THE MECHANICS OF VENTILATION.

BY GEO. W. RAFTER, C. E.

(CONTINUED.)

* * * * * * * * *

In order to farther illustrate the theory of ventilation as above set forth, a numerical application will also be made to the Assembly room in the city building of the City of Rochester.

Preliminary data is as follows:

Length =108′ 0″
Breadth= 78′ 0″
Height = 27′ 0″

Floor area, with an addition for stage =8831 square feet.

Total volume, including stage, without deduction for furniture, &c. =244,949 cubic feet.

The seats now in place accommodate comfortably 1,200 people, with standing room for 400 more. Total capacity is therefore taken at 1,600. Deducting one-half cubic foot for each seat, and 3 cubic feet for space actually occupied by each person, and making other deductions for cornices, raised floor at sides and ends, projection of stage into room, etc., and we have an available volume of 230,500 cubic feet.

Under the above conditions the floor area for a single person will be

$$\frac{8831}{1600}=5.52 \text{ square feet;}$$

while the volume for each person will be

$$\frac{230500}{1600}=144 \text{ cubic feet.}$$

Lighting apparatus consists of 112 gas burners, each consuming 4 cubic feet of gas per hour. The consumption of gas per hour, then, is $112\times 4=$ 448 cubic feet.

As previously shown a cubic foot of gas in burning produces 0.43 cubic feet of carbonic acid. Production of carbonic acid per hour from combustion of gas, therefore $=448\times 0.43=192.6$ cubic feet. Each person produces 0.6 cubic feet of the same gas per hour. Production from respiration, then $=960$ cubic feet. Total amount of carbonic acid per hour $=960+192.6=1152.6$ cubic feet.

Assume the heat from a single person to be 475 units per hour, and the heat from combustion of a cubic foot of gas to be 750 units: We have

$1600\times 475=760000$ heat-units per hour from the audience; and from the lights

$448\times 750=336000$ heat-units per hour, making a total production per hour of

1096000 heat-units.

Suppose the air supply to be at a temperature of 62° and equal to 2000 cubic feet per hour for each person, the amount per hour will be

$$1600\times 2000=3200000 \text{ cubic feet.}$$

The amount of heat required to raise a single cubic foot of air 1° at an original temperature of 60° or thereabouts is

$$0.0766\times 0.238=0.01815 \text{ units.}$$

The increase in temperature of the air supply, due to the heat from lights and people will be found as follows:

$$\frac{3200000}{13}=246154 \text{ pounds of air per hour, and}$$

$$\frac{1096000}{246154}=4.4=\text{number of heat-units to each pound of air.}$$

A single heat-unit raises one pound of air through

$$\frac{1.0000}{0.238}=4^\circ.2 \text{ actual temperature.}$$

The increase of actual temperature of the whole supply will therefore be

$$4.2\times 4.4=18^\circ.48.$$

On the supposition that the adjustment of supply to exhaust is properly made the air on leaving the hall must have a temperature of

$$62^\circ+18^\circ.48=80^\circ.48.$$

The exit per second will equal

$$\frac{3200000}{3600}=888 \text{ cubic feet.}$$

Assuming the velocity of exhaust in vertical flue to equal 20 feet per second, we have for area of said flue

$$\frac{888}{20}=44.4 \text{ square feet,}$$

or what would be preferable, two flues each with area of 22.2 square feet. Assume farther that the inflowing air shall have a velocity of 4 feet per second, the area of inlets will be

$$\frac{888}{4}=222 \text{ square feet.}$$

Assume a sectional area of 6 square feet for each inlet, and

$$\frac{222}{6}=37=\text{number of inlets.}$$

Assume again that velocity in outlets is 6 feet per second,

$$\frac{888}{6}=148 \text{ square feet}=\text{area of outlets.}$$

Also let area of each outlet be 6 square feet, same as inlets

$$\frac{148}{6}=25 \text{ number of outlets.}$$

The discussion has taken no account of the increase in volume due to the increase of temperature. Were such account taken the dimensions of outlets would be somewhat increased.

The number of changes per hour under the above conditions may be determined by two methods, either by dividing the supply per hour for each person by the volume for each person, thus,

$$\frac{2000}{144}=13.9$$

or by dividing the total supply per hour by the total available volume of the hall, thus,

$$\frac{3200000}{230500}=13.9$$

giving the same result in either case.

The discussion has also proceeded upon the supposition of no loss by conduction and radiation. We will now consider the modifications of the above calculations due to these sources of loss.

The hall is warmed by steam, direct radiation. Number of sets of radiators 18, each having an area of 60 square feet. Total radiating surface, therefore,

$$60 \times 18=1080 \text{ square feet.}$$

Amount of space heated by one square foot of surface equals

$$\frac{230500}{1080}=213.4 \text{ cubic feet,}$$

which is certainly ample for the coldest weather likely to be experienced here.

To find loss by conduction through walls and windows, we will assume inside temperature at a mean between temperature of entering air and temperature to which it is raised by heat from persons and lights, or say at 71°. Outside temperature is taken at 32°. The outside exposures are three in number, two sides and one end. We will consider the loss of heat only from the three outside exposures, neglecting the protected end, ceiling and floor.

Area of the three exposed sides exclusive of windows=6306 square feet. Area of windows=1696 square feet.

Taking formula (18) we have for the loss through walls exclusive of windows:

$a = 6306$ square feet,
$t' = 71°$,
$t = 32°$,
$k = 0.095$,
$d =$ thickness of wall$=2$ feet,

then

$$Q=0.095 \times 6306 \frac{71-32}{2} = 11487 = \text{number of heat-units conducted away}$$

through walls per hour.

For windows we have

$a = 1696$,
$t' = 71°$,
$t = 32°$.

Experiments have been made in the case of window glass, showing that neglecting d the value of k varies from 1 to 3. We will take it for this calculation at a mean value, namely, 2. We have therefore

$$Q=2 \times 1696(71-32)=132288.$$

hence the total loss by conduction per hour under the conditions of temperature assumed is

$$11487+132288=143775 \text{ heat-units.}$$

Suppose, however, instead of allowing 2000 cubic feet per hour for each person, we take what is more nearly the actual supply, that is 850 cubic feet. With that assumption we have a total supply per hour of 1,360,000 cubic feet. The amount of heat from people and lights will be the same as before. Assume temperature of air supply at 62° as previously. Amount of air in pounds

$$\frac{1360000}{13}=104615$$

Number of heat-units per pound of air is

$$\frac{1096000}{104615}=10.4,$$

making an increase of actual temperature of

$$10.4 \times 4.2=43°.68.$$

Assuming no loss by conduction and radiation, and the temperature of the outflowing air is

$$62°+43°.68=105°.68.$$

In fact loss by conduction, &c., increases in proportion as inside temperature increases, consequently the amount conducted away will be correspondingly greater than in the preceding case. Observation will show air in upper part of room to range from 85° to 95°. The writer has on several occasions observed it higher than 80° in lower part of room, and this too with windows open, and outside temperature at from 35° to 40°.

A partial exhibit has now been made of the main principles underlying the Mechanics of Ventilation. In conclusion it will be well to collate principles and facts for convenience of reference.

1. Perfect ventilation is hardly automatic. A certain amount of attention is necessary to keep any system in working order.

2. Ventilation by draught is preferable to ventilation by forcing air in, it having the advantage of supplying fresh air as fast as foul air is removed, provided of course the design is properly carried out.

3. The vacuum may be produced in case of rooms or suites of apartments by fire-places or by small flues properly connected with the rooms at or near the floor, in which gas jets are kept burning whenever ventilation is needed. In large buildings, however, the vacuum will of necessity be produced by vertical shafts designed in accordance with the principles herein contained.

Corollary.—Where gas jets are used the amount of heat from one cubic foot of gas may be taken as given in the beginning of this paper. Knowing the amount of air to be carried away per hour, the size and number of burners is easily found.

4. Perfect ventilation will cost something. To lift a thousand pounds of air 50 feet, requires exactly the same expenditure of force as to lift a thousand pounds of iron, or any other substance 50 feet.

Corollary 1.—Since to ventilate a building means there is work to be done, and consequently an expenditure of force necessary, any system professing to ventilate without such expenditure of force can hardly be other than a failure.

Corollary 2.—Careful study of the matter shows the importance of reducing friction in flues, ducts, elbows, etc., to a minimum; otherwise a large percentage of force will be expended for that purpose only.

5. Ventilation is a branch of mathematical investigation, actual construction should, therefore, be preceded by careful calculation.

6. Heating is a branch of ventilation, and should always be considered in connection with it.

Corollary 1.—In warming by heated air the current should be introduced at or near the ceiling. It is a violation of first principles to introduce it near the floor.

Corollary 2.—In designing a system of warming by heated air, provision should be made for introducing cold air in connection with the warm current, in order that the air may not enter the room at too high a temperature.

Corollary 3.—The cold air currents as per Corollary 2 should be under perfect control as well as the heated currents, in order that the proper temperature inside may be maintained under every variation of outside temperature.

Corollary 4.—Warming by steam or hot water, by a combination of the two, or by steam and hot air combined may all be exceedingly healthful, provided adequate ventilation accompanies them. These methods are all reasonably economical as regards consumption of fuel.

Corollary 5.—Warming by ordinary stoves cannot be considered desirable except on the score of economy. The objections to their use are:

(1) Difficulty of producing ventilation in connection with the warming.

(2) Cast iron, the usual material for their manufacture, when red hot allows the gases, carbonic acid and hydrogen to pass through into the rooms.

(3) The heat is irregularly distributed, causing great variations in temperature in different parts of the rooms.

7. It should be understood that ventilation by opening doors and windows is nearly as bad as no ventilation.

8. In large buildings much satisfaction, and what at the present time is of the greatest importance, much valuable information could be obtained by putting up in connection with such a system of ventilation by the vacuum method, apparatus for determining and accurately registering the results under varying conditions of outside and inside temperature. An anemometer in the main shaft with electric recording apparatus in the superintendent's office, would show at any instant exactly the condition of the ventilation. In this way regularity of action will be assured, and at the same time a collection of data of the greatest value in future building operations can be made.—*Van Nostrand's Engineering Magazine.*

THE HYGIENE OF THE HAIR.

Professor Erasmus Wilson, who is probably the highest living authority on the subject, has lately given a course of lectures on the hair before the College of Surgeons in London. They are reported in full in some of the English medical magazines, and an abstract of the more practical portions will doubtless be of interest to many readers of the *Journal.*

Cleanliness is, of course, insisted upon as of prime importance, but washing the hair is emphatically condemned. Brushing is to be preferred, as it promotes circulation, removes scurf, and is in all respects a more effective stimulant than water. Cutting does not encourage growth as much as is commonly believed, but is advantageous in the case of short, slender hairs generally called "young hairs."

Of the countless applications recommended for the cure of baldness, few are ever successful, and in the occasional instances in which they appear to be useful it is possible that sequence is mistaken for consequence, the *post hoc* for the *propter hoc.* Most of the specifics are stimulants, not excepting petroleum, which has lately been eulogized. Croton oil, though excellent as a stimulus, is objectionable on account of the irritation it often causes and which sometimes extends to the eyelids and the face. Cantharides, though milder and more manageable, is likewise liable to give rise to inflammatory congestion and vesication, and sometimes to suppuration and ulceration. The skin may be peculiarly sensitive, or the remedy may have been employed too energetically, both as to quantity and time. Professor Wilson has seen several instances in which cantharidine has been absorbed into the system and has given rise to ischuria. As a rule, therefore, he rarely uses cantharides, and then always in a guarded manner. Certainly, it is not to be trusted to the acknowledged indiscretion of the public as a popular remedy. Acetic acid, or rather strong pyroligneous acid, he has discontinued for many years; but it is still a favorite, notwithstanding its strong and disagreeable odor.

Ammonia is Professor Wilson's favorite stimulant; it is unlikely to create inflammation and its consequences; it is neither absorbable into the system, nor could it do harm if such were the case; and its odor, refreshing at the moment of its use, speedily evaporates. In a case of ordinary madesia or falling out of the hair, he prescribes a lotion composed of strong liquor ammonia, almond oil, and chloroform, of each one part, diluted with five parts of alcohol or spirits of rosemary, and made fragrant by the addition of a drachm of the essential oil of lemons. The lotion should be dabbed upon the skin of the head after thorough friction with the hair-brush. It may be diluted if necessary; it may be applied sparingly or abundantly; and it may be used daily or otherwise.

There are cases in which a less stimulating and even a refrigerating lotion may be desired, and where an objection may be raised to the quantity of oil contained in the above. In such cases a lotion of borax and glycerine, two drachms of each to eight ounces of distilled water, is cooling and refreshing; this lotion allays dryness of the skin, removes scurf, and subdues irritability.

In cases of complete baldness, and also in alopecia areata, a stronger stimulant application will be required. For this he recommends frictions with a liniment composed of equal parts of the liniments of camphor, ammonia, chloroform, and aconite, to be well rubbed into the bare places daily, or even twice a day, so as to produce a moderate amount of stimulation. In cases of ophiasis, due to neuralgia of the cutaneous nerves of the scalp, this liniment is very valuable. In other cases the liniment of iodine may be painted on the bare patches daily, or they may be rubbed with the ointment of cantharides or any other powerful stimulant. The intention of all these local remedies is to stimulate without setting up irritation; to increase the energy of circulation and innervation of the part; and in some instances to abstract the excess of fluids from the tissues of the skin by inducing exudation. But these results must be accomplished as far as possible without pain and without severity.

The constitutional treatment of alopecia should consist in the adjustment and regulation of the functions of digestion and assimilation; and, where no other special conditions are to be fulfilled, the adoption of a tonic regimen and the administration of tonic remedies. Of these last arsenic bears the palm, and may be advantageously prescribed in doses of two to four minims three times a day directly after food, and in any convenient vehicle.

Grayness, canities, or poliothrix depends like baldness on defective powers of the skin, and the indications for treatment are exactly the same, —to strengthen the part and at the same time strengthen the patient. As means of temporarily staining the hair the lecturer mentioned a weak solution of permanganate of potash, a lotion holding in suspension sulphur and acetate of lead, or the so-called *eau des fées*, consisting of the hyposulphites of lead and soda; among dyes sulphides of various metals, especially silver, the pyrogallate of iron and ferro cyanide of copper. The hair, as is well known, contains sulphur, and a solution of lead brought into contact with sulphur produces a sulphide of lead, which is black in color. Sulphur and acetate of lead in suspension and solution in water supply both the elements necessary for artificial coloration of the hair, and constitute the popular lotions sold so largely.

Actual dyeing of the hair is a more elaborate process: the hair must be washed with soap in the first place, to get rid of grease, which would otherwise interfere with the absorption of the fluid by the hairy tissue; secondly, the hair being dried, the metalic solution is to be employed and left to soak into the hair; and thirdly, the mordant fluid is to be brushed upon the part with a view to bring it in contact with every individual hair. If this operation sufficed for a considerable period, all would be well; but as the hair grows quickly, the newly-grown part exhibits its original whiteness, and another dyeing soon becomes necessary. The tone of color produced by the first application may have been perfect, leaving nothing to be desired, but the white roots of the hair cannot be reached without a fresh coloring over the whole, and then the evils become apparent. A succession of coats of color renders the hair more intensely black than Nature herself could have accomplished, and the harmony of the features of the individual is disturbed; the mellowing of the lineaments of the countenance produced by white hair is reversed by the depth of the blackness, and the features are rendered harsh and severe. The theory that an appearance of youth is maintained by the color of the hair is not consistent with fact, and there is always the danger that the hair may appear youthful, while the features themselves are expressive of old age.

As to danger to the health and constitution from dyeing the hair, Professor Wilson thinks that we cannot reasonably allege the possibility of any serious evils; for lead, to which are imputed the most dangerous of the qualities of hair dyes, enters into the composition of several of our cooling and astringent and sedative lotions, and even injections; and although undoubtedly some cases are on record of damage resulting from its internal use, Goulard's lotion is commonly regarded as one of the most harmless of our remedies. Perhaps a distinction may be drawn between its therapeutical and its cosmetical use, but it is difficult to distinguish the difference. Reference is made to some of the alleged cases of lead poisoning from the use of hair dyes, but it is suggested that a more careful examination might have found the cause elsewhere, perhaps in the water used for drinking.

It is admitted, however, that there may be cases of peculiar sensibility to the poisonous influences of lead in which these dyes may be injurious. Professor Wilson, as we have said, is high authority on these matters, but we nevertheless advise our readers to avoid all hair dyes containing lead, especially as there are preparations for the purpose that are certainly harmless,—if one is foolish enough to dye the hair at all.—*Boston Journal of Chemistry.*

Plain Directions for Preventing the Spread of Infectious Diseases.

BY J. M. MACLAGAN, M. D.

General Directions.—I. When a case of infectious disease occurs in a house, immediate notice thereof should be given to the Medical Officer of Health or to the Inspector of Nuisances, and medical advice at once procured.

The following precautions should be taken:

1. Isolate the person affected as much as possible from the other inmates of the house.

This is most readily effected by at once removing him to an upper room, if circumstances permit. The room selected should be large and airy, and the means of ventilating it, which shall be presently mentioned, at once adopted.

2. Before removing the patient, the following preparations ought to be made in the room:

All superfluous curtains, carpets, woolen articles, unnecessary clothing —in short, everything likely to retain infection, should be at once removed.

3. The patient's bed ought to be so placed as to allow of a free current of air around it, but not so as to place it in a draught.

4. The room must be kept well ventilated, under the physician's directions, by means either of a fire (when required) or an open fire place and chimney, and of windows opening to the external air. By means of the latter, ventilation is most effectually procured, so as to avoid draughts in the following manner:

Raise the lower sash of the window three or four inches, then procure a piece of wood made to fit accurately into the lower opening, and place it there. By these means free outward and inward currents of air—without causing any draughts—are obtained through the vacant space between the two sashes. When a window is merely opened from the upper and lower sash, draughts are invariably caused.

II. After removal of the patient to the room in which he is to remain, the outside of the door and door-posts should be completely covered by a sheet kept constantly wetted with some disinfecting fluid, such as Burnett's Solution, Condy's Fluid, Carbolic Acid, etc.

2. The room must be kept scrupulously clean. Before being swept, which should be done daily, if possible, the floor should be sprinkled with

Calvert's or McDougall's Disinfecting Powders, or with a weak solution of one of the disinfecting fluids already mentioned.

3. Vessels containing disinfecting fluids should be placed in the room for the reception of all bed and body linen, towels, handkerchiefs, etc., immediately on being removed from the patient, and on no account should they be washed along with other household articles.

4. Disinfectants should also be placed in all the chamber utensils used by the patient, and, after use, more disinfecting fluid should be added, and the whole contents, if possible, should be immediately buried. No chamber vessel should be allowed to remain in the room after having been used.

5. All plates, cups, glasses, etc., which have been used by the patient, should be rinsed with some disinfectant before being washed; and on no account should any vessels used in the sick room be washed along with other things, unless previously thoroughly disinfected.

6. Attendants on the sick should not wear woolen dresses, but only those made of washing materials.

7. Basins containing water, to which some disinfectant has been added, should always be at hand for the benefit of the attendants on the sick, who should not be sparing of their use.

8. No article of food or drink from the sick room should be consumed by other persons.

9. Visitors to the sick room, except in the case of clergymen and medical men, should be peremptorily forbidden: and they, when necessarily present, should, on leaving, wash their hands in water to which a disinfectant has been added, and have as little immediate communication with others as possible.

III. When a death from infectious disease occurs, the body should be at once placed in a coffin and sprinkled with some disinfecting fluid or powder, such as chloride of lime, etc., and buried with the least possible delay.

2. On no account whatever should it be allowed to remain in a room occupied by living persons.

IV. On the termination of a case of infectious disease, either when the patient is pronounced free from infection, or, in the event of death, after removal of the body, the sick room and its contents should be thoroughly cleansed and disinfected.

2. The bed and bed-clothes, and all wearing apparel used by the attendants or patient, should be thoroughly disinfected.

V. In houses where a case of infectious disease occurs, no washing, tailoring, dress making, nor any similar occupation, ought to be carried on.

2. No milk or food of any kind should be supplied from infected houses.

3. Children from infected houses should not be allowed to attend schools, and all persons from infected houses should have as little communication as possible with others, either in private houses or in public places, such as railways, omnibuses, public-houses, churches, etc.

4. Any accumulation of filth or refuse of any kind should be at once

removed from or about the premises, and disinfectants freely used. If this cannot be done by the persons themselves, immediate notice should be given to the Inspector of Nuisances.

5. The existence of nuisances of any kind and wheresoever situated should be at once reported to the Inspector of Nuisances.

VI. During the prevalence of epidemic, infectious or contagious diseases, it becomes specially important that the general laws regarding the preservation of health should be rigidly attended to.

2. Implicit trust should not be placed in so called "disinfectants." They are very useful when judiciously employed, but are by no means certain "preventives of disease."

3. Pure air, pure water, warm clothing and good food should always be obtained if possible. By their constant use less chance is afforded for an invasion of disease.

4. Temperance both in eating and drinking is essential for the maintenance of health and the prevention of disease.

5. Overcrowding in houses, workshops or schools should be strictly prohibited.

6. All houses, cottages, schools and public rooms should be kept clean and well ventilated; and frequent use of lime washing on the walls and ceilings should be made.—*Druggists' Circular.*

METEOROLOGY.

A NEW METHOD OF DETERMINING THE WIND'S VELOCITY.

BY JOHN H. LONG, OLATHE, KANSAS.

A paper read before the Kansas Academy of Science, October 12, 1877.

It having been repeated stated by certain observers in Kansas that the anemometer of the State University registered a higher than probable velocity, I was induced at the suggestion of two gentlemen connected with the institution, to test the correctness of the instrument. The apparatus used by me was very simple, consisting essentially of a hollow copper sphere suspended in front of a graduated horizontal scale. But as a more detailed description may be necessary to the understanding of what follows, I will give it here. Imagine first a perpendicular shaft of iron, eighteen feet long, whose bottom fits into a socket and to whose top is attached a swivel. To this swivel are attached several wires whose other extremities are secured so as to give complete steadiness to the shaft. Other braces are attached for the same purpose, and the swivel on top permits it to turn to suit the varying direction of the wind. A short distance below the swivel a horizontal arm, fifteen inches in length, is firmly attached to the shaft, and just below this another one is similarly attached. These two arms are equal in length and parallel to each other. To the extremity of the upper arm are fastened two fine iron wires, one, seventeen feet long, supporting a plummet, and the other, six and a half feet long, supporting the copper sphere mentioned above. This sphere is 8.5 centimetres in diameter, and weighs 135.92 grammes. To the extremity of the lower arm is attached the scale, consisting of two lath-like pieces of wood, about four feet long, fastened parallel to each other and about one-half inch apart. Between these, constituting a guide, the wires are suspended, and on the front one the graduation is made. The plumb line serves to determine the zero point, and is of no further use. By means of the swivel above and the socket below, the apparatus is easily turned, so that when the ball is deflected by the wind its vibrations may take place in the space between the two laths. The observation consists in registering the amount of this deflection from the zero point, or point in which the perpendicular line cuts the scale. It is well known that the force of the wind is not constant for any great length of time. It is hence necessary to take a great many observations, at short intervals, in order to obtain a correct mean. In my work I noticed the deflection of the ball through fifteen minutes, making a record every fifteen seconds, which gave me sixty observations for the quarter of an hour. The following table taken from my note book will illustrate:

June 19, 40 m. past	6,	def.=20 cen.			June 19, 41 m. past	6,	def=16 cen.		
$40\frac{1}{4}$ "	6,	" 18 "			$41\frac{1}{4}$ "	6,	" 18 "		
$40\frac{1}{2}$ "	6,	" 20 "			$41\frac{1}{2}$ "	6,	" 19 "		
$40\frac{3}{4}$ "	6,	" 17 "			&c.				

Cup anemometer marked 15.24 per. h.

I observed always the record of the anemometer for the same fifteen minutes, and at the close of my work, which was continued on several days to obtain mean deflections corresponding to different velocities, I had a number of such records as the above, each consisting of the position of the ball at sixty different periods.

By a well known principle of mechanics I found the force or *pressure* of the wind necessary to produce in the ball of known weight the observed deflections, and for convenience made the following table:

For deflection	of	1 centimetre,	force	=	.73 gramme.
"	"	" 2	"	"	1.46 grammes.
"	"	" 3	"	"	2.19 "
"	"	" 4	"	"	2 92 "
*	*	*	*	*	*
"	"	"60	"	"	43.8 "

Having this table of pressure, the next question is to find the wind's velocity corresponding to each of them. There are several empirical formulas, which might be applied to the solution of a problem such as this, but one proposed by Weisbach seems to be the most reliable. It is for the action of an unlimited stream, either of water or air, and by giving suitable values to some of its factors it affords an easy solution to the problem in hand. I do not know that it has ever before been applied in this way, but I find the results obtained agree very closely with those derived from a formula computed by Colonel James for the British Board of Trade. The formula is this:

$$P = z \frac{v^2}{2g} Fy,$$

in which P is the pressure of the wind, z a term dependent on the shape of the body exposed to the wind, $\frac{v^2}{2g}$ the height due to the velocity v, F the exposed area, y the density of the air. The value of z has been found from experiment to be about 0.64, so transposing the equation to find the value of v^2 we have,

$$v^2 = \frac{2g\,P}{.64\,Fy},$$

from which the numerical value of v can be easily found, as those of g, P, F and z are known. It must be observed that the value of z varies with the barometric height, making it necessary to read the barometer for each set of observations. It is now easy to construct another table, as follows:

For deflection of		1 cen.,	velocity =	3.9	m. per h.
"	"	2 "	"	5.51 "	"
"	"	3 "	"	6.74 "	"
"	"	4 "	"	7.80 "	"
*	*	*	*	*	*
"	"	60 "	"	30.2 "	"

Finally these values are substituted in the columns of deflections observed, and a mean obtained which represents the wind's velocity for the fifteen minutes of observation.

After making a large number of experiments as above described, I learned these facts regarding the anemometer at the Kansas University: First, that it never registers too much, and second, that for small velocities it does not register enough. This is due to the fact that a gentle wind, whose strength, however, is sufficient to deflect the ball, will fail to move the cups sometimes for many minutes.

The following figures will show results obtained by both methods. The first column contains the velocities determined by the deflected ball, and the second those determined for the same time by the anemometer:

5.6 m. per h.	.64 m. per h.	15.3 m. per h.	15. m. per h.
10.5 " "	4.84 " "	15 6 " "	14.88 " "
11.68 " "	10.62 " "	17 5 " "	16. " "
13.5 " "	10 89 " "	18.2 " "	18.15 " "
13 7 " "	12.81 " "	18.7 " "	18.39 " "
14.7 " "	14.5 " "	20. " "	19.2 " "
15. " "	14.5 " "	25.3 " "	25.14 " "

It will be observed that for medium and high velocities the two methods compared very well, and for low velocities, as intimated, the anemometer fails to give a large enough record. Besides showing that the apparatus at Lawrence cannot register too much, my observations have convinced me that the method is one which may be of value to meteorologists. From extreme simplicity and lightness, the instrument may be easily carried from place to place by traveling observers, and a record of the wind's velocity at any station can be obtained in a few minutes. As a check upon another instrument it may be used to advantage as just shown. The dimensions which I have given are larger than necessary. I chose them in order to have the copper ball on a level with the cups of the anemometer.—*Kansas Collegiate.*

METEOROLOGICAL—ABSTRACT FOR OCTOBER, 1877.

BY PROF. WM. K. KEDZIE.

Condensed from the records of the Kansas State Agricultural College. Lat. 39° 12′; long. 96° 40′. Height, 1,200 feet.

THERMOMETER.

Mean temperature, 53°.37, which is .24 of a degree above the mean for October for 14 years. Maximum temperature on 2d, 80°. Minimum temperature on 3d and 20th, 27°.

BAROMETER.

Mean height, 28.76 inches. Maximum height, 10th, 29.05. Minimum height, 28th, 28.39.

RAIN.

Total rain-fall for the month 207 inches; the greatest fall ever measured at this station, and 7.28 inches above the average for October for 14 years. Rain fell on 12 days.

CLOUDS.

Per cent. of cloudiness: 7 A. M., 70; 2 P. M., 71; 9 P. M., 58; mean, 66. Entirely cloudy days, 14; partly cloudy, 17; entirely clear, none. Heavy fog on 26th.

WINDS.

Northwest, 10 times; north, 2; northeast, 22; southwest, 27; southeast, 6; calm, 26.

OZONE.

Day—Maximum, 6; mean, 2.89.

Night—Maximum, 9; mean, 2.85.

FOREIGN CORRESPONDENCE.

PARIS, October 27, 1877.

Since the commencement of the present century, one-fifth nearly—18 per cent. of the death-rate of Paris, is represented by consumption. It is the most cruel of diseases, devouring the young and productive part of the nation, like a Cretan Minotaur. Dr. Lagneau, one of the highest authorities on phthisical maladies, attributes consumption to impure air and insufficient bodily exercise. It is a disease rather of race than of the individual; it is ubiquitous, not peculiar to any climate, still less to any condition; it is the associate of misery, as well as of wealth. Dr. Lagneau does not find a remedy for this scourge in change of climate or of scene; on the contrary, he is not averse to thinking, that the prevailing taste for cosmopolitanism, for "peregrinomania," as Guy-Patin designated the modern rage for going to and fro, is no stranger to an aggravation of an aggravation of the endemic. The sudden changing of officials, from the north to the south of France, and *vice versa*, contributes to the production of consumption. In Paris, the native is less subject to consumption than the immigrant part of the population; and more males perish by that disease than females. There are persons who flock to the shores of the Mediterranean to be cured of phthisis; but the climate does not prevent the ordinary inhabitants from paying their quota to the universal disease. Elevated regions, as the Alps, the Pyrenees, the Andes, the plateau of Mexico, Iceland and Norway, possess a certain immunity against consumption; but cold is not the preventive agent, since the disease exists in Christiansand, and is no stranger to Greenland. In the north of France the exemptions of young men from military service, on account of lung disease, is greater than in the southern part of the country. Misery and inefficient food do not account for the cause of consumption. In the department of the Nord, where the highest wages and best living are enjoyed, the death rate for pulmonary complaints is higher than in the department of the Morbihan, where salaries are lowest, and nourishment the worst in all France. If the disease strikes the extremes of social life, as the doctor maintains, nearly equally, there can be no doubt that insufficient sustenance must be a preponderating influence, if not in the production, at least in the development of the germ of the terrible affection. Less controversial are the doctor's recommendations to prevent consumption; these are summarily: the constant changing of air in apartments; good bodily exercise; moderation in living; avoidance of idle habits, and of a too sedentary life. Jewelers, lace-makers, tailors, and shoe-makers, are most subject to phthisis, as also soldiers leading a barrack instead of a camp life; confinement is here the predisposing agency. On the other hand, millers, wool-combers, barbers,

&c., have an equal tendency to consumption, owing to the detritus constantly floating in the atmosphere where they work. Work-shops ought to be, according to Dr. Lagneau, subjected to as severe surveillance as lodging houses and hospitals, to prevent over-crowding; all access should be given, not only to air, but to light, and in schools as much importance ought to be devoted to gymnastics, as to intellectual pursuits, and more time for recreation. Singing societies ought to be established in country towns, and every effort made to encourage manly exercises and healthful amusements, to wean provincials from their tendency to come and live in cities—those "gulfs of humanity," as J. J. Rosseau designated them.

The air is fourteen and a half times heavier than hydrogen gas—the latter being the lightest of all known bodies, hence, why it is selected for filling balloons. In practice, however, pure hydrogen is superceded by coal gas on account of its greater cheapness, and because it is always ready prepared. But coal gas is heavier than hydrogen, so that the economical preparation of the latter, is an important matter for æronauts. One of the wonders of next year's exhibition will be a monster balloon by M. Giffard, cubing 20,000 yards; it will be filled with pure hydrogen; during the summer he has been experimenting how to produce pure hydrogen not only cheaply, but in large quantities; he has employed two furnaces, of fireproof clay; the lower one filled with coke, the upper with fragments of natural oxide of iron. The coke being incandescent, the oxide of carbon generated, is conveyed by tubing, over the oxide of iron; the latter yields its portion of oxygen to the oxide of carbon, and thus forms carbonic acid which escapes into the air; the iron remains pure. Through the latter a jet of steam is passed; the iron seizes the oxygen of the vapor, and the hydrogen, that other element of water, passes into a refrigerator, and is dried over a bed of chalk. M. Giffard prefers rather the old process for obtaining hydrogen: he lines a boiler with lead, on which sulphuric acid, in the cold state, has no action; the bottom of the boiler is double, one being perforated, and through which a solution of the acid is introduced to act upon iron clippings; hydrogen is thus produced in great abundance; the sulphate of iron, hitherto an obstacle, is run off into a reservoir. It is this "wet process" of producing hydrogen that will be employed to inflate the giant balloon next year.

The project of creating a sea in the interior of Algeria, may be considered as abandoned; after being weighed in the balances by the Academy of Sciences, it has been found wanting. But this does not the less redound to the credit of Captain Roudaire, who has sacrificed his health and fortune to the survey of the projected canal of some 110 miles, to flood the desert, and make the Sahara blossom like the rose. He has also had the warm support of M. de Lesseps in the feasibility of the scheme. The region to be operated upon is the sandy waste situated some 125 miles south of Tunis; in ancient times this region was occupied by comfortable and commercial populations; to-day it is a series of dried up salt lakes, but which formerly communicated with the Mediterranean, by a strait at the depth of the Gulf of Gabes. These communications have been choked up with sand, so that what was once an active centre of navigation is a desert now, where not a trace of former civilization can be found. According to Roudaire, the area to be flooded is 10,000 square miles, to be fed by a canal 110 miles long; the estimate for the main and lateral canals is about fr. 1,400 millions. It was urged, that an immense evaporation, 39 million cubic yards during 24 hours, and double during the period of the sirocco, or equal in total volume to the quantity of water which flows in the Rhone at Lyons would occur. Now the current produced by this evaporation would so erode the banks of the canal, that the channel would silt up, and finish by being choked with sand. It was also alleged, that the evaporation of the water in the inland sea, would leave such a deposit of salt, as to make it poisonous for fish, and finally, it was more likely the rain calculated to fall from the great evaporation, would take place, not on the desert as was expected, but on the shores of the Mediterranean and the neighboring mountains.

Which is the most contagious, measles or scarlatina? These two eruptive fevers hold the first rank in being transmitted, not only by actual contact but by vicinity, the breathing of a common air or the usage of common objects. Not to mention vehicles, the leaves of a book read by a convalescent preserve the contagious principle; the folds of a garment also transport it as in the case of Hildenbrand, who brought scarlatina from Vienna to Podolia, where the disease had never been known, in an infected coat that he had never worn since eighteen months. Dr. Dumas dissents from the general opinion, that scarlatina is more pre-eminently contagious than measles; the latter malady attacks in a wholesale manner, scarlatina strikes discreetly, is eclectic, often picking out in the same family one child and sparing the rest, the parents almost habitually escaping. Contagion by measles is mostly contracted when the disease is in full eruption, or when on the decline; in scarlatina it is more uncertain, but is generally late. The question is asked, When will a Jenner appear to vaccinate for the measles and scarlatina?

M. Dransert draws attention to the singular oscillation of the eyeballs, which in some individuals suffering from the affection, move from 50 to 100 times per minute, with a rythmical regularity from one angle of the eye to the other, or from downwards upwards. This perpetual motion of the eyeballs is attributable to the fatigue of the muscles, and in the case of the Auzin miners, is the consequence of their habit of looking upwards when at their work; an excessive action of the muscles is thus produced, a kind of spasm; the afflicted when he walks, generally has the head thrown back, to relieve instinctively the muscles destined to raise the eye. Intemperance augments the infirmity, especially the day succeeding drinking. The ungraceful movement of the eyes of Albinos, M. Dransart believes, is to be attributed to a poverty of blood, and he connects them with miners, who are subject to anæmia.

All is not yet cleared up as to the physiological role of the spleen ; it is now generally supposed to take an active part in the constitution of the blood, serving too as a kind of reservoir; it also belongs to that class of glands which do not pour their secretions outside of their organs. It can be removed from the system without producing any fatal consequences; dogs experience no difference in point of health when their spleen is extracted, and the operation, it is stated, promotes the fattening of stock destined for the butcher. Dogs thus operated upon die very suddenly, and apparently from no specific cause. Once removed, the spleen cannot be reproduced; salamanders can replace some organs if destroyed. M. Schiff, states that in the case of animals whose spleen has been removed, the white predominates over the red globules of blood, as in the the case of poverty of the latter. He also observed the spleen when experimenting on dogs, secreting a special ferment which, mixing with the pancreatic juice, imparted marked aid to the process of digestion.

Boiler explosions are frequent, owing to incrustations forming on the plates. M. Heret, a well known chemist, has employed lime-water to fix or neutralize the fatty acids introduced by the steam from the greasing of the cylindrical boxes; these form a kind of soap in the water destined to feed the boilers. These fatty acids attack the sides of the boiler, producing enormous crusts of black soapy, ferruginous matter ; these isolate the metal from the water, and hence it becomes dangerously heated. By passing a solution of lime into the feed water, the calcarous soap becomes insoluble, and the glycerine rendered free exercises no action on the metal. The process has been now adopted in the French navy.

It has been defined, that man is the only animal which laughs ; Graves has stated he is the only animal that cooks, and indeed humanity may be said to be divided into two epochs, that preceding, and following, the discovery of cookery. Pre-historic man, resembled savages of the present day, whether on the continent of America, in Australia, or Polynesia, where fish, animals, and loathsome insects are eaten raw, as a kind of change from fruits. Man was not as some *savants* allege, originally a vegetarian ; the latter is perhaps an artificial kind of alimentation. Brahmins only became frugiferous when agriculture put within their reach that kind of food. Vegetables are easily consumed by birds and cattle, because they have gizzards and paunches—appropriate organs, but wanting to man; hence, the necessity of the culinary art to make rice and millet digestible. But to cook, it was essential to have fire, and for a long time humanity was deprived of this element. Indeed it was even a marketable commodity, and some tribes still carry living embers, as they camp. Fire was perhaps originally produced, as Indians still practise, by rubbing a pointed stick in a hole in wood. It appears clear, that fire was known to man, when he was contemporaneous with the mammoth, but the earliest traces of cooking utensils date from his association with the cavern bear and reindeer. A pot represents a certain civilization; often the animals were cooked in their own skins, as ostriches still are; or a hole was dug in the ground, coated with clay, filled with water, into which heated stones were plunged. Punch is thus warmed in some parts of Germany, and it was formerly a favorite plan in Ireland, to boil milk. It was woman who was in early times trusted to make the earthen pots, then to employ them, and finally to guard them, and hence, to be queen of the fire side.

Professor Ecker, of Fribourg, concludes, that the greater length of the index, over the ring finger, is a proof of physical perfection and evidence of superiority of race. F. C.

SCIENTIFIC MISCELLANY.

WONDERFUL DISCOVERIES IN THE SANDSTONE ROCKS OF COLORADO.

"Nature has borne strange children in her day," says Shakspeare, and he is not far wrong, if we may judge from some recent discoveries in the rocks of our neighborhood. While exploring some rocks in the white sandstone hog-back of the cretaceous period, near Morrison, Bear Creek — the same stratum as at Colorado Springs, a few yards west of old Colorado City —we came suddenly upon a huge vertebra, lying as if it were carved out in bas relief on a slab of sandstone. It was so heavy that it required two men to lift it. Its circumference was thirty-three inches. We stood for some moments looking in astonishment at this prodigy, and then hunted around for more relics. Presently one of the party, a little in advance, cried out, "Why, this beats all!" At his feet lay a huge bone, resembling a Hercules war-club, ten inches in diameter by two feet long. On digging beneath it, a number of smaller vertebræ were discovered, and at the base of a cliff two enormous fragments, reminding one of the broken columns of some ancient temple, or a couple of saw-logs, lay on the ground, possibly thigh bones, fifteen inches in diameter at the butt end; and in the cliff above them was another fragment sticking out of the rock like the stump of a tree. With the help of a sledge-hammer and crowbar, the rock was removed around it, and underneath lay some ribs three inches in diameter, with other bones.

The rocks in the vicinity were full of fragments. Selecting one of these, we lifted off a large cap of sandstone above it and disclosed a perfect shoulder, ulna and radius, of another somewhat smaller animal, the thickness of the bones averaging about five or six inches. This, lying as it was like a beautiful sculpture on the sandstone, we succeeded in removing exactly as we found it. Several smaller bones of animals of various sizes were discovered. We succeeded in dragging our prizes, on a temporary sled, down the cliff to the road, and bringing home to the neighboring village a wagon load of bones and depositing them in a shanty, preparatory to packing them off East to Prof. Marsh, of Yale College, for identification. The monster to whom the bones belonged could not have been less than sixty or even eighty feet long.

Along the shores of this ancient sea squatted and leapt the dinosaurus or the terrible lizards, one of whom (the lælaps) was 24 feet long. From the length of his hinder legs, it is supposed that he was able to walk upright like a biped, carrying his head 12 feet in the air. There was another still larger, 35 feet long, and of the same habits. In the air overhead, huge bat-like creatures (Pterodactyls), combining a lizard, a crocodile, and a bat, flapped their feathery wings (25 feet from tip to tip) over the sea, plunging every now and then into the water for a fish. There were birds, too; a diver (Hesperornis) five and one-half feet high, and some, strange to say, with spinal vertebræ like a fish and armed with pointed teeth in both jaws. Enormous tortoises and turtles were the boatmen of the age. One discovered by Cope, in Kansas, was fifteen feet across the end of one flapper to the end of the other. Huge clams also lay scattered over those ancient shores, twenty-six inches in diameter. Our saurian did not fall short of the biggest of these monsters; he could not have been less than sixty or seventy feet long, and probably either a Mosasaurus or lizard, allied to the Elasmosaurus.

The ocean in which these creatures lived was gradually enclosed by the upheaval of the sea bottom on the west, and soon became almost an inland sea. As the elevator continued and its area was contracted, ridges would rise, insolating portions of the sea into salt lakes and imprisoning the life in them. The stronger soon destroyed the weaker, till the water, by evaporation, becoming shallower, all life finally died, became skeletons, and, in course of ages, fossils in sandstone.—*Colorado Springs Gazette.*

ANOTHER SEA SERPENT.

On the 2d of June last the royal yacht Osborne, while cruising off the coast of Sicily, encountered what was supposed to be by many on board the veritable sea serpent. According to Lieutenant Haynes, his attention was first attracted, in a perfectly smooth sea, by seeing a ridge of fins above the surface of the water, extending about thirty feet, and varying from five to six feet in height. On inspecting it by means of a telescope, at about one and a half cable's distance, he saw a head, two flippers, and about thirty feet of an animal's shoulder. The head, as nearly as he could judge, was about six feet thick, the neck narrower, about four to five feet, the shoulder about fifteen feet across, and the flippers each about fifteen feet in length. The movements of the flippers were those of a turtle, and the animal resembled a huge seal, the resemblance being strongest about the back of the head. He could not see the length of the body, but judged it to be about fifty feet. The tail end was invisible, unless the ridge of fins which first attracted his attention, and which had disappeared by the time he had got the telescope, were really the continuation of the shoulders to the end of the object's body.

The head was not always above water, but was thrown upward for a few seconds at a time, then disappearing. There was, however, no blowing nor spouting.

This account was substantially confirmed by the statement of the engineer and of others on board. The captain distinctly saw the seal-shaped head, the immense size of the flippers, and a part of the body.

These reports were considered to be of so much interest that the Admiralty thought proper to refer them to the criticism of scientific men as to the probable nature of the apparition, and the matter was placed in the hands of Mr. Frank Buckland for the purpose, who presented the subject for consideration to Prof. Owen, Mr. A. D. Bartlett, of the Zoological Garden, Captain David Gray, and Mr. Henry Lee, and in a recent number of *Land and Water* he publishes the responses of these gentlemen.

Professor Owen does not think there is any ground for supposing this to have been an animal unknown to naturalists, but considers it probably referable to some unusual movements of one or more marine animals, either cetaceans or fishes. He, however, is entirely non-committal on the subject, beyond refusing to assent to the existence of any unknown monster.

Mr. Buckland suggests that the phenomena may have been caused by the procession of several basking-sharks, which are of sufficient magnitude to have produced at least some of the appearances.

Captain David Gray thinks that in all probability the phenomenon was produced by several small whales moving together, the look of the head and shoulders in the sketch furnished by the officers of the Osborne being quite similar to that of a whale when moving from the spectator. The appearance of the fins, which could not have come from any single whale, might possibly have been produced by a combination of several animals.

Mr. Bartlett, on the other hand, thinks it possible, perhaps probable, that the animal seen by those on board the Osborne may have been a marine reptile analogous to some of the gigantic saurians known to geologists, such as the ichthyosaurus. As illustrating the possibility of the existence of monster animals for a long time unknown to man, he cites the case of the hairy-eared, two-horned rhinocerous, caught at Chittagong some years ago—a species previously entirely unknown to naturalists, although the region inhabited by it was supposed to be thoroughly explored.

Mr. Henry Lee coincides in opinion with Mr. Bartlett as to the existence of an undescribed species, and thinks that the phenomena are not to be explained by the movements of any known species, the fact of there being no blowing nor spouting warranting the conclusion that it is not a cetacean. —*Harper's Weekly.*

A Group of Fossil Lizards.—Entering the parterre saloon of the Royal Cabinet of Natural Curiosities, containing a geognostic collection of articles found in Wirtemberg, you will observe on the right hand a group of a rare character, covered by glass. They are twenty-four fossil lizards in sandstone, which, by most skillful hands, carefully prepared, does now belong to the institution. It obtained the group within the few last years, and but recently it was exhibited to public view. The animals lie on 1.5 square meters of fine sand, just as they were formed, just as death had befallen each of them ages ago, and as the water drove their cadavers together. They lie over and beside each other, one of them completely preserved from the snout to the tail, while another is in a state of mortification, with pieces of shell and bones scattered here and there. Here we see one on its belly, there one on its back, and here again on the side, just as chance had placed the bodies—just as the sand or mud had buried and covered them for thousands of years. They cannot be compared to any now living lizards; they are as little like the now living crocodilian as they are like the now existing saurian. They seem rather to be a union of types, which, in later development, took different directions into special classes and orders. Their most essential part is the form of the head, properly to be called a bird's head; the character of the bones of their extremities as we find them in a class of lizards having a strong scaly mail, consisting of some sixty to seventy mail rings. The mediocre size of the full grown animal is eighty-centimeter. The group is altogether single in its character, and no museum of the world can exhibit a parallel case.—*Translated for the Globe-Democrat.*

The Fortunes of the Obelisks.—The sister obelisk to Cleopatra's Needle has been presented by the Khedive of Egypt to New York city. As we noted last week, it was proposed to defray the expense of transportation across the Atlantic by public subscription, but this course has since been rendered unnecessary by the magnificent offer of a well known citizen, whose name is as yet withheld, to bear all the expense, amounting to $100,000, himself. This proposal has been accepted, and we understand from the New York *World* that the contracts for the removal and shipment of the stone have been signed. At present the question is being discussed where the obelisk is to be erected when we get it; and opinion seems to be about equally divided in favor of establishing it in the centre of Madison Square, between Twenty-third and Twenty-fifth streets, on Fifth Avenue, or in the park into which it is proposed the site of the present distributing reservoir on Forty-second street and the same avenue shall be converted, after demolition of the now unnecessary reservoir.

In view of the distribution of Egyptian obelisks over the surface of the earth, one being in Rome, another in Paris, another in London, and now another in New York, it has been humorously suggested that the archæologist of a dozen centuries hence will be vastly puzzled to account for the wonderfully wide contemporaneous dispersion of the Egyptian race, which will be indicated by the localities of its monuments.—*Scientific American.*

PURE WATER.—The Board of Water Commissioners—Messrs. Brown, Walsh and Sweeny—met Wednesday afternoon at the Waterworks, for the purpose of testing the efficacy of a new filtering apparatus designed for the purification of water used by cities. A model of the arrangement was brought to St. Louis, on Tuesday last, under the charge of Mr. F. M. Mahan, of St. Joseph, one of the owners of the patent, and President of the Novelty Manufacturing Works, of that city.

The process used is an exceedingly simple one, and as Mr. Mahan remarked, it is a wonder that somebody had not thought of it before. It consists of sinking a bottomless box or float into the river, the high sides of the float quieting the disturbed waters inclosed, and, being quieted, the sediment of course settles to the bottom of the river. Within this quieting chamber is another sort of bottomless apartment, into which the water rises, and from here the water percolates through tubes filled with sand and covered at each end with perforated tin, into the receiving chamber. In a word, the water is by this process first settled and then purified by its passage through the tubes of sand, flowing into the tubes in its endeavor to find its own level.

The model used yesterday was made of tin, about half as long as a common skiff, though much higher. The trial was made off a raft lying on the river near the works, at a place where the water was unusually muddy. The float was put overboard at 3:30, and in seventeen minutes the five-gallon receiving chamber was full of water, perfectly clear from sediment or suspicion of color. The members of the Board tasted it, compared it with the element which now and then overflowed the raft on which they were standing, and seemed well satisfied that the apparatus could filter even the tawny Missouri.

The amount of water used daily by the city is 28,000,000 of gallons, and this is settled after a fashion in the wells made for that purpose. Mr. Mahan claims that one of his floats three hundred by one hundred feet, fitted up with lines of sand tubes, will be able to filter 30,000,000 gallons daily, from which supply water clear as crystal can be forced all over the city.—*Globe-Democrat.*

VALUABLE IMPROVEMENT IN LEAD FURNACES.—An improvement in lead furnaces, the invention of Mr. John B. McCurdy, is creating quite a stir in Joplin. The nature of the improvement is confined principally to the manner of introducing the blast to the charge in the Scotch hearth furnace. Instead of directing the blast through one or more circular orifices or "eyes," (the furnace of Mr. McCurdy, which is in full operation in the smelting establishment of the West Joplin Lead and Zinc Company), the furnace back is so cast as to contain just above the usual metal well, a thin, continuous air-slit which extends around three sides of the charge. The action of the blast is modified at the point of greatest convergence by an expansion of the air-slit at the points whereat the pressure is most indirect. The result of the combination of this improved form of blast with the Water Jacket back, is in the surprising increase in the quantity of lead smelted daily, and the remarkably large percentage of lead from the ore. When the patent is obtained we will illustrate this invention with a first-class engraving. Result of test runs on McCurdy's new water back:

Name of Smelter.	Mineral Smelted.	Lead Made.	No. Pigs.	Per cent.
Brewer & Cummings	3,000	2,315	27	77 1-6
" "	3 000	2,220	26	74
Lloyd & Workizer	3,000	2,315	27	77 1-6
Hains & Haugh	3,000	2,320	27	77 1-3
	12,000	9,170	107	76 5-12

ANCIENT PERFUMERY.—M. Jules Simon traces back the origin of perfumes to the early times of the Chinese Empire, and mentions a curious habit which prevailed amongst the fine ladies of the Celestial Empire of rubbing in their hands a round ball made of a mixture of amber, musk, and sweet-scented flowers. The Jews, who were also devoted to sweet scents, used them in their sacrifices, and also to annoint themselves before their repasts. As for the Scythian women, they went even a step farther, and, after pounding on a stone, cedar, cypress and incense, made up the ingredients thus obtained into a thick paste, with which they smeared their faces and limbs. The composition emitted for a time a pleasing odor, and on the following day gave to the skin a soft and shining appearance. The Greeks, as a matter of course, obtained their knowledge of perfumes from the gods. It was betrayed to them by Œnone, one of the attendants of Venus. They made such use of the invention as ought to have caused them to be very grateful to the indiscret nymph. They carried sachets of scent in their dresses, and filled their dining-rooms with fumes of incense. Even their wines were often impregnated with decoctions of flowers, or with sweet-scented flowers themselves, such as roses and violets. There were also appropriate scents for each limb, and even each feature, and the elegants of Athens resorted to such effeminate refinements of luxury in this matter as might well be ridiculed by Virgil in the lines which he puts into the mouth of Turnus. One of these refinements consisted in annointing pigeons with a liquid perfume and causing them to fly loose about a room, scattering the drops from their feathers over the heads and garments of those who were feasting beneath. Besides the luxury of mere adornment, there were most important duties reserved for certain scents. The essence of quince was given as a preservative against dyspepsia and lethargy, the odor extracted from vine leaves for clearing the brain, and that of white violets to promote digestion.—*Journal Applied Science.*

Cement for Fastening Knives and Forks into their Handles.—Take one pound rosin and half pound of powdered sulphur; melt together, and mix in about twelve ounces of fine sand or powdered brick. Fill the cavity of the handle with this mixture, melted. Make the shank of the knife or fork quite warm and insert in place and let it remain until cold, when it will be found to be firmly fixed. The handles of knives and forks should not be put in hot water.

A subscriber says a pen scratches because the inside corners wear off, and look like the bottom of a M. To restore it, rub the end square and even on a whetstone. Bring the slope of the nib to a point to suit you. Then, holding the pen nearly upright, roll it around, holding the nib on the stone to make the point round. Make it as round and smooth as you can.

Mineral Oil Fuel.—The neighborhood of the naphtha springs of Bakou has suggested the idea of using mineral oil as fuel for the Ruasian flotilla stationed in the Caspian. Three vessels are already heated by this means; and the result has proved so satisfactory that the boilers of four other vessels are being altered to adapt them to the new system.

BOOK REVIEWS.

Pre-Historic Races of the United States of America; by J. W. Foster, LL. D. Fourth edition. Chicago, S. C. Griggs & Co.; London, Trübner & Co. pp 416 octavo, $3.00. For sale by Matt. Foster & Co., Kansas City.

The subject of anthropology has interested scientific men for centuries, but it is scarcely a half century since they began to question the literal correctness of the history and traditions which assign to man an antiquity exceeding the six thousand years of Biblical story. It is probable that the investigations of travelers among the Asiatic races convinced them that this period was entirely too short for the rise, development and decay of their systems of civilization, and that broke the ice for and impelled the numerous and profound researches which have been made in recent times into the history of the human race in the remoter ages.

The result of these researches seems to be that man's history began at least with the animals of the Quaternary, if not with these of the Tertiary period, and that he has gradually risen from a savage being to the degree of intelligence he now manifests.

The French geologists and archæolgists have, perhaps, more than those of any other country, devoted themselves to the study of anthropology, and it is to the early researches of such men as Bouè, Cuvier, Tournal, Christol, Boucher de Perthes and Lartet that the world is indebted for the knowedge of pre historic man which it now possesses, for while many of the scientific men of England and Germany soon took up the question and joined in the investigation of the subject with great zeal and industry and ultimately, perhaps, even surpassed the French in the extent and value of their discoveries, still the chief credit for the conception and inauguration of the work must be given to the former.

In England Kemp, Frere and Dr. Buckland were among the earliest writers who advocated the high antiquity of the human species, while later Sir Charles Lyell, Milne Edwards, Sir John Lubbock and others have added the weight of their opinions to the same side of the question.

Numerous works have been written upon the pre-historic races of different portions of the world and all possess the greatest interest to readers of almost every class, but none that we have ever seen surpasses and scarcely any equals that of Col. Foster.

From his wide experience as an explorer of the physical geography of the Mississippi Valley and the Lake region, and as an investigator of and a writer upon ethnology and its kindred subjects, he was admirably fitted to prepare a work of this kind, based as it is largely upon his own personal observations, and it will certainly be the decision of every reader of this book that he has been remarkably successful in conveying accurate, scientific information and learning in a clear, easy and popular style, thus making the subject attractive and interesting to all classes of readers and the work especially valuable to the student of anthropology and archæology.

Two chapters are devoted to the antiquity of man, in the first of which the progress of discovery of its evidences in Europe is set forth, and in the second that of the United States is recorded. In the third chapter the mound builders and the geographical distribution of their works are considered, and in this chapter are described the wonderful earthworks and mounds at Marietta and Newark, Ohio, Cahokia, Ills., and St. Louis and Charleston, Mo., all of which we have personally examined, and in addition those of the whole Mississippi Valley, New Mexico, Colorado and the Atlantic and Pacific coasts.

Chapter IV is devoted to Shell mounds and their geographical distribution; Chapter V to mounds and enclosures; Chapter VI to Mound builders and their arts and manufactures; Chapter VII to Ancient mining by the mound builders; Chapter VIII to the Crania of the mound builders; Chapter IX to Manners and customs as a basis of ethnic relations; Chapter X to the solution of the question, Who were the mound builders?; Chapter XI to the Unity of the human race, and Chapter XII to Chronometic measurements as applied to the antiquity of man; thus going over the whole subject in a systematic, comprehensive and philosophic manner, which is equally as satisfactory to the reader as it is demonstrative of the author's erudition and ability.

No one will lay the work down without feeling amply repaid for reading it, whether considered as a mere work of scholarship or as a compendium of information upon the topics discussed.

The mechanical execution of the work is first class and is fully equal in paper, printing and binding to anything from the older publishing houses of the East.—[ED.

INTRODUCTION AND SUCCESSION OF VERTEBRATE LIFE IN AMERICA, an Address before the American Association for the Advancement of Science, at Nashville, Tenn., August 30, 1877, by Prof. O. C. MARSH, Yale College. pp. 57.

This is one of the most interesting papers we have ever read and we give below an imperfect summary of it.

Starting out with the proposition that "to doubt evolution is to doubt science, which is but another name for truth," Prof. Marsh gives in detail the evolutionists' explanation and exposition of the origin, rise and development of animal and vegetable life on the earth from its earliest dawn in the Palæozoic age down to the triassic period in which appear the first and lowest forms of mammalia; thence he laboriously and carefully traces step by step the development of the mammalian tribes, beginning with a single small Marsupial found in the Trias, followed by the Edentates, the Cetaceans, the Sirenians, the Ungulates, Rodents, the Insectivores, the Carnivores, and culminating in the Primates, composed of Lemurs, Apes and *Man*.

The differences between the fossil vertebrate life of America and that of Europe seems to consist principally in the fact that it did not appear in the former during the Archæan, Cambrian or Silurian periods, although during this time more than half of the thickness of American stratified rocks were deposited; that the Devonian fishes of America were less numerous but larger than those of Europe; that in the great inland cretaceous sea of North America the true osseous fishes were most abundant and the most perfectly developed. The American Amphibians were all of moderate size as far as their osseous remains have been found, but the foot-prints left by some whose remains have not been discovered indicate animals larger than any of the class yet found in the old world. There is no evidence of Reptiles in America in any rocks older than the Carboniferous, while true reptiles have been found in the Permian rocks. A striking feature of the

American cretaceous fauna, as contrasted with that of Europe, is the almost entire absence in our strata of species of Icthyosaurus and Plesiosaurus which abound in many other regions, but we far surpass them in Mesosauria and Dinosauria. The American Pterodactyles, also, differed from those of Europe in being larger and having no teeth. Europe carries off the palm for the oldest fossil birds, the oldest American forms being the Odontornithes, or birds with teeth, lately found in the Kansas chalk.

The Tertiary of Western America comprises the most extensive series of fossil vertebrates known to geologists and it was here that the oldest representative of the horse, the diminutive Eohippus, was discovered and made by Huxley to assume the apex of the evolution pyramid, the crowning glory of the theory.

The most remarkable of the Mammals yet found in America are the *Tillodontia*, which are claimed to combine the characters of several different groups, viz: the Carnivora, the Ungulata, and the Rodents.

It is a singular and notable fact that no traces of any Anthropoid Apes or of any Old World monkeys have yet been detected in America. Man, however, who doubtless crossed into America by way of Behring's Straits, and at his advent became part of our fauna as a mammal and a primate, has left his bones and works from the Arctic Circle to Patagonia, principally, however, in the Post Tertiary, though there is evidence that he existed in the Pliocene.

Regarding the position of man on the earth and among the other members of the Primate group, the Professor says, "the oldest known remains of man on this continent differ in no important characters from the bones of the typical Indian, although in minor details they indicate a much more primitive race. These early remains, some of which are true fossils, resemble much more closely the corresponding parts of the highest Old World apes, than do the latter our Tertiary Primates, or even the recent American monkeys. Various living and fossil forms of Old World Primates fill up essentially the latter gap. The lesser gap between the primitive Man of America and the Anthropoid Apes is partially closed by still lower forms of men, and doubtless also by higher Apes now extinct. Analogy, and many facts as well, indicate that this gap was smaller in the past. It is certainly becoming wider now with every generation, for the lowest races of men will soon become extinct, like the Tasmanians, and the highest Apes cannot long survive."

In closing the article he speaks as follows: "If the history of American mammals, as I have briefly sketched it, seems, as a whole incomplete and unsatisfactory, we must remember that the geological tree of this class has its trunk and larger limbs concealed beneath the *debris* of Mesozoic time, while its roots doubtless strike so deeply into the Palæozoic that for the present they are lost. A decade or two hence, we shall probably know something of the mammalian fauna of the Cretaceous, and the earlier lineage of the existing mammals can then be traced with more certainty."

The objection to this address as "history" is that the facts stated by Professor Marsh are all selected with express reference to and in support of the text that "Evolution is Science and Science is truth," and that the facts tending to antagonize the evolution theory are not given equal prominence, as exact history demands that they should be. Not that we would charge so eminent a philosopher and student with unfairness in discussing scientific subjects, but simply take the position that his train of thought, whether in exploring the geological formations of Kansas and Colorado, the archæological remains of California, or in pursuing his investigations among the rare specimens of palæontology in the cabinets of Yale College, has been directed in the channels of evolution and natural selection, and he naturally and consequently fails to do that justice to those facts which rise in strong opposition to his theories which the equities of the case demand from an impartial historian. With this view of the matter, the address seems, perhaps, to have been given too general a title.

The quotations given above show some admissions of weakness in the argument, some missing links in the chain and the inconsequence of the conclusion arrived at, and prove very clearly that while evolution may account for some points in the history of progress on the earth, it requires too much purely theoretical support to be accepted as entirely satisfactory as a whole until it has passed far beyond its present status.—[Ed.

EDITORIAL NOTES.

By an error in the book bindery a few copies of the October number of the Review were defective. Subscribers having received such copies will be supplied with perfect ones upon notifying the editor.

KANSAS CITY ACADEMY OF SCIENCE.

The academy met at its rooms on the evening of the last Tuesday in October, President Van Horn in the chair.

The exercises of the evening were an article on Cone Sections, by Professor J. M. Greenwood, which we regret not being able to reproduce in the Review from the fact that it requires all the illustrations given by the Professor, by black-board drawings and models, to bring out its numerous interesting and valuable points; and one on the Loss of Heat and Light in the Solar System, by Judge E. P. West, which constitutes the first article in this number.

These meetings of the Academy are extremely interesting to those who attend them but the attendance is rather limited, considering the number of professional men, teachers, students and other intelligent people who make up so great a portion of our population.

On motion, T. S. Case was appointed to read a paper at the next meeting, on the last Tuesday of November. The subject will be "Some of the Objections to the Evolution Theory."

The very interesting article on "Electrical Conduction," by Prof. R. C. Kedzie, of Lansing, Michigan, noticed in the Review of last has been reprinted in the London *Telegraphic*

Journal. This may be regarded as quite a tribute to its merit, as the *Journal* is one of the best electrical authorities published. Prof. Kedzie is a relative (brother, we believe,) of Prof. W. K. Kedzie, of the Kansas State Agricultural College.

MORRISON OBSERVATORY.—Professor C. W. Pritchett, of the Pritchett School Institute, Glasgow, Mo., announces the opening of this observatory, which has recently been adequately endowed by Miss Morrison, and supplied with the best instrumental outfit for meridian and equatorial work in this portion of the country, and invites the attention of all who desire instruction in spherical and practical astronomy. He also promises an occasional article for publication in the REVIEW, and we expect to make arrangements with him for a series of astronomical notes similar to that furnished the *Scientific American* from Vassar College observatory.

WE are indebted to the *Science Observer*, the *Industrialist*, the Lawrence *Journal*, the Brookfield *Gazette*, the Galena *Miner*, and the *Druggist's Circular*, all of which are excellent papers in their various classes, for complimentary notices since our last issue.

EARTHQUAKE.—A distinct earthquake shock was felt in this city at about twelve o'clock, noon, on the 15th, inst., sufficient to jar buildings perceptibly, but without doing any damage. It was also observed at Omaha, Council Bluffs, St. Joseph, Topeka, Iowa City, Yankton, and other points in the West. At Topeka the motion seemed to be from north to south, while at Council Bluffs it is reported as having been from east to west. Judging from the telegrams received from the above named points, the motion was greatest at Yankton, where it is described as having been the most severe ever experienced in that valley. At Omaha and Council Bluffs it was quite sharp and the destruction of some high buildings was seriously threatened. At Topeka and here a very slight vibration only was observed, which lasted but a few seconds.

NOTICES OF PUBLICATIONS RECEIVED.

NORTH AMERICAN REVIEW, Nov.—Dec, 1877; pp 200. J. R Osgood & Co., Boston: $5.00 per annum; single copies, $1.00.

This standard work has for more than 60 years maintained its high position among the most able and scholarly periodicals of the world, and, while perhaps at times rather "heavy" for general readers, it has always borne a high character as an indisputable authority on all topics treated in its pages. Within the past few months a modernizing change has been made in the character of its articles and its editor now aims to "make the *Review* a vehicle for the intellectual forces which are at this moment working in men's minds." How well he has succeeded in this effort is indicated by the table of contents, which is as follows:

Resumption of Specie Payments, by Hugh McCulloch, Judge W. D. Kelley, Gen. Thomas Ewing, David A. Wells, Joseph S. Ropes and Secretary Sherman; Cavalier de la Salle, by Francis Parkman; The War in the East, by Gen. Geo. B. McClellan; The Functions of Unbelief, by Thomas Hitchcock; The Southern Question, by Charles Gayarre, of Louisiana; Michelangelo and the Buonnarroti Archives, by T. Adolphus Trollope; America in Africa, by Gilbert Haven; The Situation in France, by a Paris Resident; How shall the Nation Regain Prosperity? by David A. Wells; The Ultramontane Movement in Canada, by Chas. Lindsey; Contemporary Literature.

This number is published by James R. Osgood & Co., Boston. The *Review* in the future will be published by D. Appleton & Co., New York. For sale by all booksellers.

THE KANSAS COLLEGIATE. A monthly publication devoted to the interests of the State University, Lawrence, Kansas.

This is a monthly Literary and Scientific periodical, conducted by the students of the Kansas State University. Its contributors are frequently the Professors of the University, and the articles published in the last number are of an unusually interesting character, from the fact that they are mainly papers lately read before the Kansas Academy of Science. Price, 50c per college year.

THE AMERICAN JOURNAL OF SCIENCE AND ARTS, monthly; New Haven, November, 1877; 96 pp. Price, $6.00 per annum; single numbers, 55c.

We gladly add this veteran Scientific Journal to our list of exchanges, it being undoubtedly the most valuable periodical of the kind in the United States and a high authority in Great Britain and on the continent.

Its editors and proprietors are Professors James D. Dana, B. Silliman and E. S. Dana, assisted by Professors Asa Gray, Walcott Gibbs and J. P. Cooke, Jr., of Cambridge; Professors H. A. Newton, S. W. Johnson, G. J. Brush and A. E. Verril, of New Haven, and Prof. Geo. F. Barker, of Philadelphia, a greater array of scientific talent probably than can be found connected with any similar journal in the world. The present number contains articles of marked interest and value by Profs. O. C. Marsh, J. D. Dana, W. Pengelly, Chas. B. Warring, J. W. Mallet and Simon Newcomb; with chapters of Scientific Intelligence on Chemistry and Physics; Geology and Mineralogy; Botany and Zoology; Astronomy and Miscellany, by the proper editors above named respectively and other scientific writers and workers.

POPULAR SCIENCE MONTHLY, November, 1877.

As usual this excellent magazine reaches us promptly, and as usual is filled with carefully written and intensely interesting articles. For the general reading public there is no periodical published which seems to equal it so far as as popular scientific articles are concerned. Among the most interesting and valuable articles in the present number are The Growth of the Steam Engine, by Prof. R. H. Thurston, (illustrated); Modern Troglodytes, by Felix L. Oswald, M. D.; Man and the Glacial Period, by Thos. Belt, F. G. S, (Illustrated); Effects of Study on the Eyesight, by Ward McLean. Price, $5.00 per annum; single number, 50c.

THE JEWELL, November, 1877; Vol. III No. 1; Evans Bros., Liberty, Mo.

This is a collegiate magazine, published by the Professors and students at William Jewell College. It is devoted to general Literature and comes to us after a brief suspension with an attractive and varied table of contents. We wish it a most successful career. Price, $1.50 per annum; single numbers, 15c.

THE NEW YORK MEDICAL JOURNAL; Vol. XXVI, Number 5; pp 112; monthly. D. Appleton & Co.

This long established and popular Medical Journal is edited by James D. Hunter, M. D., who is well known to the medical profession as able and experienced physician and writer.

The present number contains a large number of first class articles, one of which, from the pen of Prof. Austin Flint, Jr., we copy in full, giving as it does the latest and most exhaustive experiments upon and investigation of the causes of the apparent want of breath at times when the lungs are full of air, as well as accounting for various forms of convulsions and perhaps of epilepsy itself. The reports of proceedings of societies, clinical observations and operations are very interesting.

Price per annum, $4.00; single number, 40c.

BINGLEY'S ANIMAL KINGDOM; Hubbard Bros., Philadelphia, 1877.

This popular work is now being delivered in this place, the agent, Mr. L. L. Boynton, having sold quite a large number of copies among our citizens. It is an excellent thing for teachers and heads of families for use in the instruction of children, and is written in so attractive a manner as to be interesting and instructive to the general reader of almost any age.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

VOL. 1. DECEMBER, 1877. NO. 10.

EVOLUTION.

SOME OF THE OBJECTIONS TO THE EVOLUTION THEORY.

BY THEO. S. CASE, KANSAS CITY, MO.

For some time before I was appointed to read a paper at this meeting of the Academy I had been determining to my own mind that I ought to look up the facts in opposition to the theories of Darwin, Haeckel and Huxley, for fear of being overwhelmed and forced along with the current by the mere ponderosity of the mass of argument, inference and induction poured upon me from every side in the scientific journals with which I exchange my little Monthly, and which of late have formed the principal part of my reading; and your action in so appointing me has merely hastened my action in the matter. My natural inclination from early teaching and training is to discredit the whole theory of Evolution and Natural Selection and to pin my faith to the doctrine of a "supreme conscious and creative power" which "was from the beginning and ever shall be," and to whose wisdom and omnipotence are due the earth and all things within it, but I believe that I am sufficiently free from prejudice to consider the subject fairly and candidly, and also sufficiently interested in science to appreciate and admire the honest and faithful labors of all true scientists. With this bias and this spirit of fairness equally governing me, I have made my investigations among all classes of authorities within my reach, and herewith give you the results, not attempting to disprove the existence of facts, but merely indicating some objections which to me seem, with present actual knowledge, almost insuperable.

The Evolution theory is no new thing, being readily traceable all along the history of science, from the times of Aristotle to the days of philosophic speculation in the 17th century; through the groping and uncertain experiments and researches of the alchemists to the brilliant and wonderful discoveries of modern scientists in the broad fields of physics, chemistry and biology.

Among the comparatively recent explorers and writers, Lamarck may be regarded as the father of the Evolution Theory, having, as long ago as 1801, in his work on the Vertebrate animals suggested the idea, among many other similar ones, that "Nature, in the long ages during which the world has existed, may have produced the different kinds of plants and animals by gradually enlarging one part and diminishing another to suit the wants of each," and later, in 1809, having written a work called "Zoologic Philosophy," to prove that the way in which the Creator has formed different plants and animals, has been by altering them gradually from simple to complex forms. Another of Lamarck's theories was that new organs could be produced in animals by the simple exertion of the will, called into action by the creation of new wants, and that the organs thus acquired could be transmitted by generation, which was regarded by the naturalists of that day as so unreasonable and preposterous that no attention was paid to it; though, indeed, apparently not only equalled but far surpassed by the evolutionists of the present time.

With these ideas for a starting point or foundation, the grand biological theories of Darwin and others gradually grew, or were evolved, until they have reached such dimensions as absolutely to undertaké, not only to account for all the progressive steps of animal birth, life and growth without acknowledging the necessity of Divine influence or action in any of the steps, but even, as Tyndall has recently done, to refuse "to invoke the supernatural in accounting for the phenomena of human life," and "to seek in the interaction of social forces, the genesis and development of man's moral nature."

Supporting their theories by the fact that as the varied forms of animals and plants in different portions of the world became known, it became more and more difficult to separate the different species and decide which were, and which were not, descendants of one parent; by the additional fact that all the animals of each class were formed upon the same plan; and by the still further discovery that the embryos of all animals are so precisely alike, at first, that those of man and the higher quadrupeds cannot be distinguished from those of the lower animals, such as fishes and reptiles, they began to build these theories up by assuming certain points as true without sufficient proof. Thus, they began to read geological history like a printed book, to assume that succession was development, that because reptiles followed fishes in geological order, and birds reptiles, and quadrupeds birds, and monkeys quadrupeds, and man monkeys, necessarily reptiles were more highly developed than fishes and descended from them, and so with the other animals as they successively appeared on the earth, culminating in *man*, who presents in his feeble frame and defenceless construction all of the excellences of his predecessors in an intensified and perfected condition, with an entire avoidance of their imperfections.

Of course, in following out a theory of this kind, many of the essential facts were wanting, many important links missing, and it became necessary to invent other theories, draw new inferences from newly discovered facts, or supply from imagination those missing links. All this has been done ingeniously, and in many cases, most plausibly. For instance: to account for the comparative scarcity of close links between fossil animals, it is urged that nearly all of the rocks of the earth's crust are made up of others which have been destroyed, and, of course, the intermediate links of progression with them. Just at present efforts are being made to account for the absence of certain necessary geological stratifications or formations, with their needed fossil links in the chain of succession, by putting forth the theory of Catastrophes in the earth's history, as they are called by Prof. Lyell and later by Mr. Clarence King; and Critical Periods, as they are called by Prof. LeConte of California; which means in brief that, as the growth of the earth progressed, certain accidents happened, by which certain strata were either omitted, or to some extent commingled or combined with each other, or checked altogether in their formation; thus accounting for missing links which are necessary for one theory, by advancing other theories perhaps equally insupportable in point of fact, or at least upon which even the theorists themselves are not agreed.

Even with all these theories and their supporting theories, questions based upon them continually arose, which seemed unanswerable, and required the evolution of a new theory to explain. For instance, those who admitted the doctrine of succession wanted to know why these forms of animals and plants should succeed one another and gradually pass into the forms of the living animals and plants of our day? And other questioners wanted to know, on the other hand, how the gradual alteration of plants and animals came about?—*i. e.*, why they did not follow the types of their ancestors?

To meet these questions the Darwinian theory of Natural Selection was put forth, and was most eagerly grasped and universally welcomed and has been used by all of his adherents, from that day to this. Natural Selection may be briefly defined to be "the choosing out by nature, or natural causes, of those plants and animals which are best fitted to live and multiply," or, again, it may be said that the theory of natural selection is, "that nature only allows those animals to live which (by means of superior strength, or swiftness, or some other marked peculiarity) in some way escape the dangers which overtake their neighbors, and thus in time the race becomes altered to suit the life it has to lead." Of course, this theory logically requires that every change produced by it shall be for the benefit of the possessor; that is, for his own immediate and sole benefit, and not in any respect for the benefit of his descendants. This should be borne constantly in mind in considering the subject of Evolution, otherwise we may be led astray, and overlook the absence of many important links in the chain of progression.

This theory is held to explain and account for all of the difficulties in natural history, whether found in the emergence of animal life from the dim Eozoic ages into the secondary formations, or in stepping from the comparatively recent Tertiary into the Quaternary, and thence into the Present.

By this theory, eked out by that of Evolution and supplemented by those of Catastrophes in geology and Critical Periods in the earth's history, it is believed by their adherents that all the steps in the development of protoplasms, through the intermediate grades of insects, mollusks, reptiles and quadrupeds, and finally terminating in *man*, can be fully shown, and any missing links fully and satisfactorily accounted for.

That the evolutionists themselves do not agree as to the value of the Natural Selection theory will appear further on.

Taking up first the doctrine of Evolution or successive, dependent development, I will point out such objections and obstacles as I have found in reading upon this subject recently, together with the few additional ones which have occurred to my own mind after giving due credit to the indefatigable researches and plausible arguments of such careful and conscientious workers and writers as Darwin, Huxley and Marsh.

Going back to the geological ages, and beginning with the Eozoic, we find the earliest traces of organic life in the St. Lawrence limestones, and the possessor of it in the shape of a foraminiferous creature composed of jelly and protected by a strong covering or skeleton of carbonate of lime and growing to an immense size. This animal was appropriately named Eozoon, or the "Dawn animal," in honor of its having probably been present at the dawning of life upon this globe. Now, what did this animal develop into? Was any other and higher form evolved from his almost homogeneous structure? Evidently not, for even at the present day explorers of the ocean depths find beds of foraminiferous, calcareous matter, identical in character and doubtless identical in origin with those of the remotest Laurentian periods; and not only this, but they find the Foraminifera of the present day swarming in astonishing numbers and as actively engaged in manufacturing carbonate of lime as was the Eozoon of those days. We find them living under similar conditions of absence of light and vital air, and of enormous pressure, and finally we find them being fossilized in the same way, and except in dimensions, almost unchanged, undeveloped, in any particular from the protoplasmic mass of the Eozoic ages.

In the next succeeding period, known as the Primordial or Cambrian, fossils are very scarce and especially in the western hemisphere, where the Eozoon lived and flourished and where, naturally and in accordance with the Evolution theory, we should have expected to find evidences of an advanced stage of animal life in its developing successors. In Europe, however, some fossils have been found in this series, many of which are similar to the Eozoon, and others are the first representatives of the great class of Mollusks, called Lingulæ. Now, singular as it may seem, in spite of Evolution and Natural Selection, these little shell-fish, these Lingulæ, have continued to exist and thrive almost from "the beginning" until now, maintaining their original forms and peculiar characteristics throughout all this incalculable time.

Among the fossils of the Primordial age are also found quite abundantly the Trilobites, which continue to abound in every formation, from the Cambrian to the Carboniferous, and whose descendants, if they had any, which has been questioned, but which the recent investigations of Mr. Walcott among the Trenton limestones render quite certain, may be found in the existing horse-shoe or king crabs, whose habits of life, manner of locomotion and organic structure are almost precisely similar; proving that Evolution has done nothing towards developing the Trilobites into higher organisms.

Though animal life was not very abundant in the Palæozoic ages, it is pretty well established that three of the great subdivisions of animals, viz: the Radiata, the Mollusca and the Annulosa were represented even in those days, while Dr. Bigsby in his *Thesaurus Siluricus* enumerates more than 900 species existing in the Primordial alone, many of which were as perfect in form and structure as any of their descendants, many of which were supplied with structures totally diverse from each other and yet admirably subserving similar ends, and many of which possessed organs, like the multilocular eyes of the Trilobites, as perfect and complex as those possessed by similar animals of the present day.

Coming to the Silurian ages, we pass hurriedly over the huge crustaceans, cuttle-fishes and star-fishes, which seem to have attained their maximum of size and perfection in that age and to have passed almost entirely away, though their sadly deteriorated descendants still exist in our modern seas and oceans, and take up the grand, striking feature of its animal life, the Vertebrate Fishes, which suddenly made their appearance, springing into existence, Minerva like, full armed and equipped, and with structures allied to existing sharks, which occupy the summit of fish organization. This unheralded appearance of vertebrates in the Silurian waters, without previous intimation through any approximating forms of animal life, and of vertebrates whose descendants, almost unchanged in form, structure or habits of life, now swim in our modern seas, is one of the stumbling blocks of the evolutionists. To meet it, the theories of catastrophes and critical periods, with their apparently irreconcileable stages of almost endless, advanceless duration, and then of conveniently "rapid evolution," their "lost intervals" at times and their "fewer and longer steps" at others, have been invented or invoked. Even the Darwinian theory of the "survival of the fittest" cannot aid them here, for, at the time of the appearance of these fishes, and throughout the Silurian age, the waters were filled with giant crustaceans, Nautili and Polyps, so numerous that they almost covered the bottom of the sea, and, of course, possessed of ravenous appetites, and yet they permitted these small vertebrata to appear, grow, multiply, and finally prey upon them and become the monarchs of the deep.

Coming now to the Devonian age, and hastening swiftly over it, we find the Trilobites approaching their end, while the vertebrate fishes, both Ganoids and Placoids, rise to the zenith of their power and development with no recognizable ancestors, (except those which appeared so unaccountably in the preceding Silurian age), but with descendants innumerable and in a direct line down to the present day.

Coming next to the Carboniferous age, we find that it is, so far as living beings are concerned, the most complete of the Palæozoic periods, or, as it has been beatifully and graphically described, "the summation and completion of them all, and the embodiment of their highest excellence." The few insects that appeared in the Devonian age have largely increased in numbers, though but three species are represented: And singularly enough these three orders are yet represented on the earth in the shape of weevils, mayflies and cockroaches, all of which, though vigorous enough for all of our uses, are mere pigmies in comparison with those of the Carboniferous age. They also possessed, even in this the dawn of their existence, the complex and compound-lensed eyes which render their descendants the wonder and admiration of the most scientific men of modern times.

In this age we meet, for the first time, mollusks, in the familiar shape of common snails, *on land.* Hitherto all animal life seemed to have been confined to the oceans and seas. Now, however, they begin to appear on land, and again we must exclaim, how remarkable! for these snails present almost identically the same form and appearance as those we find to-day in the marshes and low grounds along the margins of our Missouri and Kansas rivers.

Here we also find, suddenly introduced into the geological history, without any evidence of ancestors, either near or remote, those immense reptiles or semi-reptiles which are so closely imitated in form and habits by the alligators and crocodiles of the torrid zone.

The fishes of the Carboniferous remain confined to the two orders of the Ganoids and Placoids.

Upon reaching the Permian age, which has been called the twilight of the Palæozoic day, we find it characterized by the appearance of *true* reptiles, as distinguished from those of the preceding age, which, by some naturalists, are placed among the lower grade Batrachians. Few of the previous orders, however, survived the violent alternations of upheaval and depression in the Permian age, with the rapidly changing chemical conditions necessary to the building up of its varied lithological formations, and its probable periods of intense heat and cold. Certain it is, however, that we have pointed out some feeble and apparently defenceless animals in the Palæozoic ages which possessed similar complex structures and organisms to those of the later days of the earth's history, and that, whether they survived the catastrophes of the Permian period in some unexplored geological region of its crust, as Professor Cope has suggested in accounting for the sudden appearance of new forms of animal life in the Tertiary, or whether they were completely extinguished before its close, there is no satisfactory fossil evidence that they were evolved one from another. On the contrary, the rocks of that period show the same marked differences in orders and species that are seen to exist between similar animals of the present day. The Foraminifera of those remote ages are found in the ooze of the ocean to-day; the cuttle fishes, nautili, king crabs and vertebrate fishes are met with in our seas almost in the identical forms in which the Palæozoic rocks present them to us, and the powers and influences of Evolution and Natural Selection seem to have modified them so slightly as to render it doubtful whether, in a single instance, one of these orders presents a higher development than it did at the close of the Permian age, thousands and thousands of years ago.

The next grand division made by geologists is known as the Mesozoic or middle age of the earth's history. Its earliest period is called the Triassic, which, though differing but slightly in general features from the Permian, in which the animal forms of the Palæozoic were seen to disappear, is characterized by such a remarkable change and activity in the domain of life that, as has been fitly said by an eminent explorer and writer, "the geologist, whose mind is filled with the forms of the Palæozoic period, feels himself a sort of Rip Van Winkle, who has slept a hundred years, and awaked in a new world." Having buried the animals of the past in the depths of the Palæozoic rocks, it seems wonderful, as we ascend to the suceeding Triassic strata, to come suddenly upon the comparatively well preserved remains of gigantic Saurians, some of which possessed a muscular development, a complicated tooth structure and a general organization of a far higher type than those of any living reptile; birds of greater size, of a brain development probably superior to, and blood circulation similar to, those of the present day; and land lizards of huge size, possessing many of the attributes of the higher vertebrata and some of those of the mammalia.

If these animals were evolved or developed from previous orders or species, where are the connecting links which prove their descent from anything that existed in the Palæozoic? None have been found. Huxley in England and Marsh in America themselves admit that "the Trias offers at present the first unquestioned evidence of true reptiles," and can only avoid the dilemma in which they are placed, by seeing in the fragments of fossil anatomy which they are studying, *hints* of relationship which are to them "sure *prophecies* of future discoveries." But prophecies are not facts. When these discoveries are actually made, as they are certainly liable to be, no one will be more ready to welcome them than the adherents of the doctrine of creation, who will see in them still stronger evidences of Divine power and wisdom.

Looking along the line of geological history still further, we find, in the same Triassic formation, the first Mammal making its appearance; a pigmy among giants, it is true, but at the same time a genuine, undoubted mammal, worth hundreds of those "prophecies of future discoveries" just alluded to. This little animal belonged to the marsupials, now as then, the lowest form of mammalian life, but, as I think, a striking illustration of the failure of the Natural Selection theory of Darwin; for while even Professor Marsh has not been able to trace them into any higher and better developed later forms, it has, despite its being the weakest and most incapable of the animals of those days, whether we consider its muscles or its brain, outlived all the powerful monsters of the Mesozoic, and, notwithstanding the oft asserted infallibility of the doctrine of the "survival of the fittest," presents the obstacle to the development theory that, low as it started in the origin of its life, its successors and descendants still live, confined to two species in America and Australia, and still remain examples of the lowest order of mammals on the earth, but little, if any, superior to the feeble Microlestes which stole into the Triassic forests among the giants of the Mesozoic times.

Of the vast numbers of enormous Saurians found in the waters of the Mesozoic age, none outlived that period; but many of the turtles and crocodiles of that day have been continued and now exist in almost the same forms as their pre-historic progenitors, not only of the comparatively recent Cretaceous periods, but even as far back as the Trias.

An examination of this whole Mesozoic period shows conclusively that before the end of this age again all the prominent forms of life peculiar to it had reached their maximum and, at its close, many of them had become extinct, while numbers of the weaker forms before alluded to, such as certain Foraminifera, mollusks and crustaceans of the Primordial ages, were continued through it, and still continue.

In the next geological age, known as the Tertiary or Neozoic, animal life seems to have again commenced with Foraminifera and mollusks, as the remains of such fill the earlier rocks of the period, though the fossil remains of fishes, reptiles, birds and mammals are also found in its lower deposits.

The peculiarly characteristic feature of the Tertiary is the rise and progress of its mammals. We find them on land and in the water, and we find among them apparent types of the animals now existing, though, as Lyell indicates and Dawson remarks, "they are not the survivors of the Fauna and Flora of the Wealden, but a new creation."

Without going into details, we find again that the animals characteristic of and belonging to the Tertiary age, such as the huge megatherium, the mastodon, machairodus and palæotherium, culminated and disappeared before its close, leaving no descendants, while many of the smaller and apparently less capable animals of the same period survived and passed on into the succeeding age.

Passing over the Glacial period, which dispersed and destroyed most of the animals of the Pliocene age, we hasten to consider those which appeared upon the earth in the Post Glacial period and which now exist upon it with man. These were not known in the Pliocene, and some of them, which we designate domestic animals, seem to be man's natural companions, and essential to his existence upon the earth, even in the present condition of mild temperature and freedom from the horrible monsters of past ages.

Again we find facts, which, in view of the claims of the advocates of Natural Selection, are surprising, and apparently tend to antagonize that theory. We find the remains of many animals which, in the days of primitive man, abounded and flourished, of which there are now no survivors known; and these were not puny and insignificant animals either, but numbered among them the woolly elephant, the woolly rhinoceros, the Hippopotamus major, the Irish elk and the cave bear, all of which were highly organized animals, quite as capable of sustaining themselves in the struggle for the "survival of the fittest" as the sheep and the ox, which have been, since the advent of man, his valued coadjutors and allies.

Having now arrived at the point in the world's history when Man comes upon the scene, we propose to spend a little time in indicating the main weaknesses of the Evolution theory as regards his origin. To use the words of another, "Let us now turn to the picture presented by the theory of the struggle for existence and derivation from the lower animals. It introduces us first to an ape, akin, perhaps, to the modern orang or gorilla, but unknown to us yet by any actual remains. This creature, after living for an indefinite time in the rich forests of the Miocene and earlier Pliocene periods, was at length subjected to the gradually increasing rigors of the Glacial age. Its vegetable food and its leafy shelter failed, and it learned to nestle among such litter as it could collect in dens and caves, and to seize and devour such weaker animals as it could overtake and master. At the same time its lower extremities, no longer used for climbing trees, but for walking on the ground, gained in strength and size; its arms diminished and, its development to maturity being delayed by the intensity of the struggle for existence, its brain enlarged; it became more cunning and sagacious, and even learned to use weapons of wood and stone to destroy its victims; so it grew into a fierce and terrible creature, "neither beast nor human," combining the habits of a bear and the agility of a monkey with some glimmerings of the cunning and resources of a savage.

When the Glacial period passed away our nameless Simian man, or man-like ape, might naturally be supposed to revert to its original condition, and to establish itself as of old in the new forests of the modern period. For some unknown reason, however, perhaps because it had gone too far in the path of improvement to be able to turn back, the reversion did not take place. On the contrary, the ameliorated circumstances and wider range of the new continents enabled it still further to improve; ease and abundance perfected what struggle and privation had begun; it added to the rude arts of the Glacial period; it parted with its shaggy hair, now unnecessary; its features became softer, and it returned to vegetable food. Language sprang up from the attempt to articulate natural sounds; fire making was invented and new arts arose. At length the spiritual nature, potentially present in the creature, was awakened by some access of fear or some grand and terrible physical phenomenon; the idea of a higher intelligence was struck out, and the descendant of the apes became a superstitious and idolatrous savage."

It is unnecessary to follow the quotation any further to show how he came at last to obtain possession of religious ideas, since the stern and inexorable logic of Spencer leads irresistibly to the same conclusion as the recent declarations of Tyndall, namely: the exclusion of a knowledge of a Creator and the possibility of his works; and hence the poor savage would waste his time in elaborating any system of religion or religious faith.

In opposition to this theory of the origin of man, the following points are urged:

First.—There is nothing in the science of natural history which tends to sustain the idea of the simpler forms of life continuing to progress and change into the more complex forms. In all such physical changes the operations of Nature are in a circle; the seed changes into a plant, a shrub, a tree; the tree gives off seed and dies. So in animal life; like begets like, and no amount of hybridizing can change the essential characters of the parent stock into a new order or species. In this view such naturalists as Professor Kölliker and M. Flourens concur, and Pæschel, author of the "Races of Man," clearly demonstrates that among the sharply defined animal forms any abandonment of original types is followed by the complete extinction of the family. We see in every day life that plants and animals changed from their ordinary forms by cultivation and hybridizing, will return to their original forms when neglected and allowed to run wild.

Second.—The theory of Creation must be admitted by even those evolutionists who, for the origin of life on the earth, go back of protoplasm, Moneres and Bathybius to the meteoric dust of Sir William Thompson. The process of life must commence somewhere, and the whole theory must rest at last upon creative force, for it is just as difficult to account for the origin of the most infinitesimal protoplastic germ or atom of meteoric dust as for any one of the complicated organisms of higher life.

Third.—Animal forms running back to the Foraminifera of the Primordial ages, the Nautili and cuttle fishes of the Silurian, the Placoid fishes of the Permian, and the turtles and crocodiles of the Cretaceous, but more particularly, the animals known to be identical in time of origin with man, not less than 6,000 years ago, have come down to us without intermingling of races or changes in form or structure; and the longer these periods of separate parallelism have existed, the worse for the evolutionists.

Fourth.—The assumed connection between the Anthropoid apes and man has never been proven by the discovery of any intermediate link either in the near or remote past by the keenest scented evolutionist or student of Palæontology. Agassiz, Mivart and Verchow agree that no links do now or ever did exist between man and apes, while Agassiz sustains Wallace in the opinion that a special creative act of the Deity was required for the development of man. It might also be urged here that an "intrusive interference" on the part of Deity in *creating* man, and simply *evolving* the other animals from each other, is far more inconsistent with a philosophical view of the origin of life than a steadfast and unvarying adherence to "natural law;" hence if it be admitted that such an exception ever was made, the creative theory is best suited to philosophical thinkers. "*Aut omnis aut nullus.*"

Zoologically speaking, the apes are no nearer man than several other species of animals, unlike in form, either mentally or physically, since they do not belong to the same genus, family or order. Physically, if any connection could be found to exist, it would probably be directly opposite to that claimed by the evolutionists, since in their natural condition apes are by far fitter for the struggle for life, whether in resisting the attacks of other animals or in withstanding the vicissitudes of climate and weather. Besides this, anatomically speaking, apes differ more or less essentially from man in their brains, skins, skeletons and teeth, and the adaptation of these various parts to the necessities of each animal. In regard to their brains, which differ very widely in size from that of man, it is only necessary to say that while the brain of an ordinary white man measures about 90 cubic inches, that of the Negro 85, that of the lowest order of men as much as 68, and that of the smallest adult human being known, a female Hottentot idiot, 62½ cubic inches, that of the *largest* gorilla is only 32 cubic inches in capacity. Besides this, the difference between the brains of men and apes is most marked in the number of secondary convolutions, which are developed in a different order, *i. e.*, those which appear first in man appear last in the ape. If the development of brain is arrested in a child, causing idiocy, the resemblance to that of the ape is less rather than more striking than if the child's brain had become fully developed.

M. Quatrefages concludes an exhaustive argument on this subject, in which he has summed up the contents of a number of contemporary works, as follows: "With regard to the Simial origin of man, it is nothing but pure hypothesis, or rather, nothing but a mere *jeu d'esprit* which everything proves utterly baseless, and in favor of which no solid fact has as yet been appealed to."

The very oldest human skulls ever found showed a brain capacity of 75 inches, and a shape almost entirely similar to that of the existing Caucasian species; so that there is no evidence from the very remotest period of man's life on the earth that his brain ever approximated in size that of the monkey; nor even, so far as brain capacity is concerned, that recent man has been developed or evolved from the prehistoric man. In fact, Dr. Broca, President of the French Association at the recent meeting at Havre, in an address on the "Human Fossil Races of Western Europe," declared that of the three distinct races of prehistoric men, the last or latest known, called the race of Furfooz, was not equal in point of intelligence to their immediate predecessors. All these things render it extremely improbable, at least, that the human brain was developed by natural selection from that of the ape or any of the lower animals.

Still further, apes not only fall below *man* in mental power, but below several other animals which are never by the wildest stretch of the imagination associated with him, such as the dog and horse, both of which surpass the highest apes in intelligence and adaptability to surrounding conditions, and none of which could, under any stress of external circumstances, leave the natural line of development and put on clothing to protect themselves against cold, manufacture arms to defend themselves, or make their food, by cooking, more digestible and acceptable; while on the other hand it is very certain that man cannot attain the opposite of these things by natural selection or evolution. Finally, man is separated from the most developed of apes by faculties of mind, such as conceptions of good and evil, right and wrong, beauty and taste for art, reverence for his Maker, and lastly a hope of happiness in the future life, none of which can be experienced by the most exalted brutes. As M. Quatrefages says, "It is not by his body that man has acquired that empire that he possesses, but he owes it to his intelligence, of like nature, but immensely superior to that of animals."

Coming at last to the question of creation or evolution, we find, as before observed, a point blank irreconcileability. There is no compromise on the part of the evolutionists. They deny in a breath both creation and God. Spencer and Tyndall do so without hesitation, and Draper but feebly recognizes the superiority of the Law Maker to the natural laws He has established. To show how the least atheistical of them talks, I will quote a few lines from Draper, who delivered an address on the subject of Evolution before the Unitarian ministers, at their Institute in Springfield, Mass., last month. He says: "The hypothesis of evolution asserts that from one or a few organisms all these that we see have been derived by a process of evolving or development. It will not admit that there has been any intervention of divine power." "The hypothesis of creation asserts that Almighty God called into sudden existence, according to His good pleasure, the different types of life that we see." "Creation reposes on the arbitrary act of God; evolution on the universal reign of law." "As to the origin of organisms, it (evolution) withholds for the present any definite expression. There are, however, many naturalists who incline to believe in spontaneous generation." Speaking of Newton's *Principia*, he says, "it gave undisputable reasons that Kepler's laws are a mathematical necessity. For the finger of Providence it substituted mechanical force, and thus the reign of Law, that great essential to the theory of Evolution, was solidly established." Speaking of the various stages of embryonic life, from the simple cell to the fully developed individual, he says, "common sense revolts against the idea that these transformations are in the individual due to divine intervention. In that, as in the case of the earth, they must be due to natural law." Again, he says, "Nature never selects, never accepts or rejects; knows nothing about duties, nothing about fitness or unfitness. Nature simply obeys laws." Again when speaking of the genealogy of organisms, he says, "the dominion of law is everywhere manifest. The capricious intrusion of a supernatural agency has never yet occurred." And yet after all this apparent exclusion of a creator, we are asked to believe that the effect of the Evolution theory upon us is to make our "conceptions of the unchangeable purposes, the awful majesty of the Supreme being more vivid." This may be plain to philosophic scientists, but not to the ordinary reader.

Now, in brief reply to Draper, those who oppose the Evolution theory ask why is creation necessarily *"sudden?"* Upon referring to the first chapter of Genesis we find the word "create" applied to only three acts, namely: The creation of the Heavens and the earth, the creation of great whales, and the creation of man in the image of his maker. In all other acts the subordinate words "form," "make" and "build" are used. Now is there anything which necessarily implies suddenness of action in the words "In the beginning God created the Heaven and the earth?" Who can tell how long a period the expression "in the beginning" covers? No theologian of the present day undertakes for a moment to establish as a fact that that the act of creating the Heavens and the earth was instantaneous, but simply that it was clearly and purely an act of creation, and not of forming or making or building up from materials already created. The word defined "create," according to Bishop Ely, one of the most eminent of Hebrew scholars, is "evidently the common word for a true and original creation, and there is no other word in Hebrew which can express that thought."

Who asserts, as Mr. Draper assumes, that "Almighty God called into sudden existence the different types of life that we see?" No theologian that we know of claims either suddenness of call into existence or that all the different types of life that we see were called into existence at the same time, but simply that God created them in his own time, at such periods as he thought proper and wisest, and under such laws as he in his infinite wisdom established.

Further, we claim that the whole theory of Evolution depends at last upon the creative power of God, because even Darwin had to start with one or more organisms which were already created, and evolved all the rest from them, while the most earnest advocates of spontaneous generation have so far absolutely failed to satisfy even such willing, but fair-minded, atheists as Tyndall, that any living organism can be produced spontaneously.

The attributing of the succession of life and the development of species continuously from the simpler to the more complex forms, from the protoplasms, through the invertebrates to the vertebrates, and finally to man himself; the attributing of these supposed processes to what Prof. Draper calls "natural law," a "process of evolving or development," the "universal reign of law," and the rejection of "divine intervention" and the intrusion of "supernatural interference" as revolting to common sense, and afterwards the admission that all these things manifest the "unchangeable purposes of the supreme being," seem to my mind a manner of stating the case unworthy of so powerful a thinker. To deny in one sentence the divine intervention, and to call the active exercise of his power in the processes of Nature "capricious intrusion," and in the next to make so broad an admission of the manifestation of his unchangeable purposes, is to destroy the effect of all Draper has said, and to convict him of reasoning in a circle. Spencer and Tyndall do not thus stultify themseles by appearing to place God in a subordinate position to the laws he has made. They boldly adhere to their premises and follow them to their logical conclusions, that there was no creation, that there is no God, but that every step in the phenomena of life can be accounted for without invoking the supernatural, and that even the genesis and development of man's *moral* nature are solely attributable to the interaction of social forces.

In support of the Creation theory we must call attention to the sudden and most remarkable increase of animal forms in that part of the Tertiary age known as the Miocene period, as it is impossible for the necessarily slow development of evolution to have accomplished it. The few mammals found in the beds of the previous or Eocene period are comparatively unnoticeable, but when we turn the corner, as Prof. Williamson says, "it appears as if some great magician had waved his wand and in response to the magic summons, life of the most varied character and in forms most dissimilar to what immediately preceded, flash into existence," and as he further says, "this unexplained outburst of new life demands the recognition of some factor not hitherto admitted into the calculations of the evolutionist school."

One of the most striking proofs of the truth and correctness of the Evolution theory is claimed to have been recently perfected by the discovery of the remains of the Eohippus in the lowest Eocene of the Tertiary deposits of Western Kansas, by the celebrated American naturalist, Professor O. C. Marsh. This Eohippus is claimed as the original progenitor of the modern horse, having four complete toes and a rudiment of the fifth on the front feet and three behind. In size not exceeding a fox, and with 44 teeth, this horse, imperfect as he is, holds the place of the apex of the Pyramid of Evolution, the crowning glory of the series which terminates in a domestic animal so indispensable to man that these same evolutionists account for man's earlier absence in different portions of the earth by the absence of the horse. Is it not strange that we find no evidences in ancient or modern times that our progenitors, the apes, ever made any use of this indispensable animal?

The next higher representative of the horse is found in the more recent Eocene, and has lost the rudimentary toe of the front foot, and has also secured a change of teeth. This link, which is called Orohippus, is but little larger than Eohippus, and shows a greater though still distant resemblance to the modern horse.

Near the base of the Miocene a third closely allied genus named the Mesohippus is found, which is about as large as a sheep and one stage nearer the horse, having but three toes and a rudimentary splint on the fore foot, and the teeth are still changing.

In the upper Miocene a fourth form is found, the Miohippus, which is larger than its predecessor and has its three toes more nearly of a size.

Coming to the lower Pliocene, we find the next step represented by the Protohippus, which is yet more equine and grew to be as large as an ass. Still retaining the three toes, it differs from the others in having only the middle one long enough to reach the ground, similarly to the Hipparion of Europe. Still ascending in the Pliocene, we find the Pliohippus, which is the last in the series before reaching the true horse, having lost the outside toes and become in other respects equine. In the upper Pliocene we find Equus himself which roamed in the Post Tertiary period over both Americas.

This seems, in its general aspects, a very complete and satisfactory genealogy, and it has proved so to Professors Marsh and Huxley, the latter of whom was especially gratified and delighted upon first seeing Prof. Marsh's specimens at New Haven. But when it comes to be subjected to the critical test of Evolution and Natural Selection themselves we find many links wanting; when we scrutinize these alleged continuous changes from the four-toed Eohippus to the one-toed horse of the present day and ask in what respect was the animal benefitted by the changes, and where is that gradual alteration which the necessities of each individual demanded in his own person, the answer still comes, not fully accounted for! We lack proof that this digital reduction was caused by the peculiar manner in which the mechanical strain operated upon the foot of the horse, as is claimed by Prof. Ryder, in a recent article written for the *American Naturalist*, because other animals, as the elephant and ox, using their feet in the same manner and probably dating back as far in the history of the earth as the horse, have respectively five and two toes. We also lack proof that the original four-toed Eohippus was descended or evolved from any previous animal. As Prof. Marsh says himself that he can offer no better illustration of the progress in vertebrate palæontology than this, we may hold it up as the best demonstration of their theory that the evolutionists have yet found, and ask how conclusive it is and how imperfect it is?

Per contra, I will quote a few lines from Clarence King, who has explored the Tertiary formations of Western America with the same zeal and earnestness, and the same scientific care and philosophical spirit as Professor Marsh. He says: "Those two authorities (Huxley and Marsh), whose knowledge we may not dispute, assert that the American genealogy of the horse is the most perfect demonstrative proof of derivative genesis ever presented. Descent they consider proved, but the fossil jaws are utterly silent as to what the *cause* of the Evolution may have been. I have studied the country from which these bones came, and am able to make this suggestive geological commentary: Between the two successive forms of the horse there was a catastrophe which seriously altered the climate and configuration of the whole region in which these animals lived. Huxley and Marsh assert that the bones prove descent. My own work proves that each new modification succeeded a catastrophe. And the almost universality of such coincidences is, to my mind, warrant for the anticipation that not very far in the future it may be seen that the Evolution of environment has been the major cause of the evolution of life; that a mere Malthusian struggle was not the author and finisher of evolution, but that He who brought to bear that mysterious energy we call life upon primeval matter, bestowed at the same time a power of development by change; arranging that the inter-action of energy and matter, which make up the environment, should from time to time burst in upon the current of life and sweep it onward and upward to even better and higher manifestations. Moments of great catastrophe, thus translated into the language of life, become moments of *creation*, when out of plastic organism, something nearer and nobler is called into life."

Now, let us see how the advocates of Evolution agree among themselves. Mr. Clarence King, who is referred to above as the latest advocate and reviver of the catastrophic means of accounting for missing links in the chain, thus speaks of Mr. Darwin's theories: "Whatever change takes place by Natural Selection in uniformitarian ages, according to Darwin advances by spontaneous, aimless sporting, and the survival of those varieties best adapted to surrounding conditions, and of these conditions the biological relations are by far the most important of all. By that means and that alone, it is asserted, species came into existence, and inferentially, all the other forms, from first to last. This is the gospel of *chance!*" Having thus given his opinion of the Natural Selection theory, he proceeds to give his own view of the continuity of life through and beyond one of his catastrophes in Nature, thus: "When catastrophic change (as for instance from the Palæozoic to the Mesozoic period) burst in upon the ages of uniformity and sounded in the ears of every living thing the words 'change or die,' plasticity became the sole principle of salvation. Plasticity, then, is that quality which, in suddenly enforced physical change, is the key to survival and prosperity. And the survival of the plastic, that is, of the rapidly and healthily modifiable, during periods when terrestrial revolution offers to species the rigorous dilemma of prodigious change or certain death, is a widely different principle from the survival of the fittest in a general biological battle during terrestrial uniformity. In one case it is an accommodation between the individual organism and inorganic environment, in which the most yielding and plastic lives. In the other it is a Malthusian death-struggle in which only the victor survives." * * * "At the end of an interval of accelerated change only the most plastic would have deviated from their late forms and reached the point of successful adaptation, which is survived in health."

Prof. Cope differs from King altogether, rejecting his theory that catastrophic disturbances produce great destruction and re-introduction of life, and ascribes the sudden appearance of new species wholly to migration.

I have also been informed by a most reliable gentleman that one of the most distinguished geologists of the west, who has been associated with Prof. Marsh in most, if not all, of his explorations among the fossil remains of Kansas and Colorado, not only refuses to accept the Evolution theory, but on the contrary claims to have found many facts that convince him that it is untenable. Thus we find that the evolutionists themselves cannot harmonize even in their theories, although necessarily based upon the same facts, and that those who labor with them sometimes fail to agree with them; whence, we again conclude that the natural laws of progression offered us as a substitute for creation are by no means so clear that one who runs may read; at least all may not read alike.

I have now gone pretty much over the whole subject, and while I have omitted much that might have been said, I feel that in view of the admissions of the imperfections and the incompleteness of the theory of Evolution by Huxley, Darwin, Marsh and others, and their hopeful reliance upon the devleopments of science in the future for its perfection, we may rest our case here until the objections pointed out have been met, and also rely upon the Providences of God, explained by the unquestionable proofs obtained by impartial scientific research, for enlightenment as to his inscrutable acts in the past, as well as his unchangeable purposes for the future.

MEDICINE AND HYGIENE.

NEAR SIGHTEDNESS IN SCHOOL CHILDREN.

BY PROF. J. M. GREENWOOD, KANSAS CITY, MO.

Of late years scientific research in the various departments of human thought has set in motion a mode of mental activity that makes free to question all phenomena whether physical or material. It was in this spirit of inquiry that Prof. Donders, some thirteen years ago, made a statement which has since attracted considerable attention in Europe and also in America. He was of the opinion that if a definite number of students, say, of a university, should have their eyes examined at regular intervals during their course, the statistics thus obtained would indicate astonishing results in regard to the wide-spread prevalence of near sightedness among such a class of persons.

The object of this essay is to trace briefly the results of some observations made to test Prof. Donders' statement; secondly, to give a brief account of the causes of near sightedness and the remedies therefor as advocated by others; and lastly, to present such opinions as I have formed in regard to this disease of the human eye.

These divisions, for convenience, will be discussed in the order enumerated.

Two years after Prof. Donders made his statement, Dr. Cohn, of Breslau, published the results of the examination of thirty-three schools, including the university. The examination embraced 10,160 pupils, 1,004 of whom were near sighted, and only 28 of them had near sighted parents. Only one in twenty-five of the children the first half year in school was found to be afflicted. The examination was confined to biennial grades and extended over a period of fourteen years of school life. The longer the pupils had been in attendance the greater the percentage of increase and of those having been in the school fourteen years, 63.6 per cent. were near sighted.

Recently Drs. Loring and Derby examined 2,265 pupils in the city schools of New York. The proportion of natural shaped eyes among the children between six and seven years of age was 87 per cent. and of those twenty to twenty-one, 61 per cent. In St. Petersburg, pupils of the same ages in school as the American children were found in the first class, 13.6 per cent., and 43 per cent. in the latter. The percentage in the Königsberg schools in the corresponding classes was 11.1 in the former and rising in the latter to 62 per cent.

In the college of the city of New York, 549 students were examined and the following results reported: Introductory class, 29 per cent.; freshmen, 40; sophomore, 35; junior, 53; and senior, 37 per cent.

An examination of 300 students in the Brooklyn Polytechnic School showed 18 per cent. in the academic and 28 per cent. in the collegiate department.

There were 630 pupils examined in the Cincinnati public schools: In the district schools ten per cent. were purblind; in the intermediate grades fourteen per cent.; and eighteen per cent. in the high and normal schools.

Last February, Dr. Lucien How was appointed to examine and report on the public schools of Buffalo, which he did in the following March. Dr. How examined the eyes of 1,003 pupils—20 per cent. he reported short sighted and 12 per cent. long sighted. No pupils six years old and under had defective eyes; but at seven he found 5 per cent. purblind; at eleven, 11 per cent.; at thirteen, 19 per cent.; at eighteen, 26 per cent., and those over twenty, 43 per cent.

All of the conditions of this examination were carefully noted, and may be classified under the following sub-divisions: 1. The precise condition of the pupil's vision. 2. The position of the body. 3. Illumination of the school room. 4. Relaxation of the eyes or body for long or short intervals. 5. Hygienic conditions.

In the city of New York the percentage of the children was recorded with regard to nationality. The nationalities represented—German, American, and Irish, and with the following results, viz: German, 24 per cent., American, 19 per cent., and Irish 14 per cent.

Dr. Peter A. Callan examined 457 colored pupils in schools Three and Four of the city of New York, and found but 2.6 per cent. of the pupils near sighted, although their ages were from five to nineteen.

The first and second divisions may be condensed into the following extract from the November number of the *Popular Science Monthly:*

"Resuming now the consideration of near sight, we proceed to suggest some of its principal causes, as follows:

1. Too early use by school children of books, slates and writing paper, or copy-books, when black-boards and models would be better. Type and script letters and figures and their primary combinations, at least, should never be taught from books, but from large and perfectly formed models, printed on cards and hung on the wall. When the eye and the memory are sufficiently trained to easily recognize and name each letter and figure at sight, and when some knowledge has been gained of the power of letters and figures in combination, then the same forms in books will be at once familiar as old acquaintances, and may be studied without straining the sight. To train the hand without straining the sight presents a great practical difficulty. In the large schools, of course, all the children can not go to the black-board; but a considerable practice in drawing large lines and simple objects on good sized slates, in a sort of free-hand style, should precede the formation of letters and figures, and when these are begun they should be made of generous size. A correct position, meanwhile, should be an imperative requirement; and, until it becomes habitual and easy, good work should be held to be of secondary importance. Hard slate-pencils and greasy slate surfaces should not be permitted; both should be subject to systematic inspection.

2. Ignorance or laxity on the part of parents and primary teachers in permitting faulty positions of the head, body and book during reading, study and writing, and in not seeking early to secure the intelligent co-operation of the pupil by simple and appropriate physiological instruction.

3. A prolonged and steady looking at an object or at objects near the eye, though at proper distance, without rest or frequent change of the visual focus, as in long and absorbed novel reading, intense study, or persistent diligence in needlework.

4. The practice of reading or otherwise using the sight at too short range. This results in part from insufficient light, or from its faulty direction, so that the hand or body throws a shadow on the page, or so that the direct rays fall upon the eye, causing undue contraction of the pupil, while

the page is in the shadow. It results also from improperly graded desks, from small and poor type and inferior printing-ink, and from faulty color and quality of printing-paper; also from pale writing-ink—pale when used—and from the substitution of the lead pencil for the pen, especially in the evening.

5. A prone or forward position of the head too long maintained or frequently repeated, and becoming a habit. This results from reading or studying with the book in the lap and from the use of desks not graded to the height of the pupil. Dr. Howe reports pupils varying eighteen inches in height seated at the same grade of desks. The distance of the eye from the page should not be less than twelve nor more than eighteen inches. Having the desks set too far from the seats also induces this faulty position. The front of the desk should overlap the seat one or two inches.

Donders says: 'In the hygiene of myopia the very first point is to guard against working in a stooping position.' He favors high, sloping desks, and indicates 'rectilinear drawing on a flat surface' as a class of work which is especially objectionable.

6. Since a vitiated atmosphere is a frequent feature of the school room, it may not be amiss to add here that the effect of bad air is indirectly to injure, if not to destroy, the sight."

Three kinds of eyes are recognized in this discussion, namely: Normal, near sighted and long sighted. The first brings the rays of light to a focus on the retina; the second, in front of the retina; and the last, behind it. The difference in eyes consists chiefly in the direction of the axis of the eye from front to back, and also in the convexity of the crystalline lens.

A pertinent question is, what change, if any, is produced in the shape of the eye to accommodate it to objects whether near or remote?

To explain how near sightedness is produced, some contend that when the object is near, the muscles that turn the eyes toward the nose press on the eyeballs, elongating them and consequently increase the elliptical form of the crystalline lens, and that this is the cause.

Admitting this to be correct, how can it be demonstrated? is a question that will puzzle, I apprehend, the author of the article in the *Popular Science Monthly* as well as Dr. Wm. Dickinson, who has written on the same subject in the *American Journal of Education*. The question thus presented is, How does the eye adjust itself? By external pressure of the inside muscles? By a forward or retrograde movement of the crystalline lens between the aqueous and vitreous humors? Or by contractions and relaxations of the suspensory ligaments and ciliary muscles?

Let us proceed to test these theories.

Hold the flame of a candle near a person's eye and a little to one side, and look into the eye from a proper distance, and three images of the flame will be seen, two upright, and one inverted. The cornea reflects one upright image, and the front of the crystalline lens the second, while the third is reflected from the concave surface of the back part of the crystalline lens.

Now let a person look at a near flame and then look at one greatly removed, but in the same line of vision, or *vice versa*, and the first and third images remain unchanged. If it were the external pressure of the muscles which changed the shape of the eye, the flame from the cornea would have exhibited a different form, but no such change can be detected, nor is there any difference in the third image. As the question is now narrowed down, the change is found to be in the frontal portion of the crystalline lens, and hence the outside muscular pressure theory must be abandoned.

That the lens by some process unknown, but imagined, moves itself bodily backwards or forwards between the two humors is, to say the least, untenable; neither can it be that the muscular contraction or expansion of the iris, owing to the intensity of light, is the cause, for the iris may be removed and vision not be impaired.

Having dismissed the external and the movement theories as inadequate, the last appears to fulfill the necessary conditions, to-wit: The lens is kept in position by the suspensory ligaments, and is therefore somewhat flattened out. Now when the ciliary muscle contracts it relaxes the ligaments and the lens becomes more convex, and returns to its former shape when the muscle relaxes again. It will be observed that the frontal portion of the lens only is made more or less convex, and the convexity depends upon the distance the object is from the eye.

A MORE GENERAL STATEMENT.

Notwithstanding the testimony of the learned gentlemen who have written and adduced bewildering statistics on near-sight, I believe that the so-called causes are effects of remoter causes that they have strangely overlooked in the multiplicity of details.

The world is governed by law, which is only another name for uniform influences that produce definite effects. Of the animal, we speak of the law or conditions of growth, and we summarize the whole process in three words—food, exercise, and rest. Without proper food no animal functions can be long sustained, and to give intensity and activity to effort appropriate exercise is necessary—yea, indispensable,—and without regular intervals of rest the sturdiest organism is soon worn out.

To draw universal conclusions from the particular cases examined is not the safest mode of reasoning, and yet it is evident that the general drift of the investigation, so far, establishes the fact that the more highly civilized the society and the more universal the culture, the greater the tendency to near-sight. The same process of reasoning would seem to warrant the conclusion that when all people become cultivated, perfect sight will be a thing of the past.

But there are modifications of these premises which should not be omitted in drawing inferences.

An analysis of 26,000 cases reported would indicate (1), that nearly all cases of near sight originate in the school-room; and (2), that the number increases rapidly the longer the pupils are in school; also the analysis enables us to group those examined into a few classes, namely: white pupils, colored pupils, artisans, laborers, and professional characters. The examinations, however, have been confined almost exclusively to white children.

Let it be borne in mind that the white children examined lived in cities, probably a large number of them never lived elsewhere. These children have had a restricted range of vision and owing to the smoke in the atmosphere hovering over the cities where they lived, it was impossible for them to see objects at any considerable distance. These restrictions impose conditions which superinduce near sight, and owing to the presence of these limitations may be attributed that abnormal state of the tissues of the eyes, rendering them easily susceptible to extraneous influences; in other words, the eyes of such have not the power of resistance. External circumstances conspiring, the usual treatment of the school precipitates the disease. It is suspected, furthermore, that during the transition or formative period food plays no unimportant part in enfeebling the action of the visual organs. Repeatedly experiments have shown that food will not only change the composition to some extent of the tissues, but will even change very materially the nature of the animal itself.

The presence of this disease, then, is due largely to a general enfeeblement of the organs of sight, caused primarily by the want of appropriate exercise and the lack of nutritious food, either or both of which would be sufficient to produce derangement of the eyes. Every organ of the body is made stronger and healthier by appropriate and regular exercise, and the eye is no exception to this rule—the testimony of the observant everywhere and our daily experience confirm it. The hunter on the far-off plains, the sailor on the ocean, the boy on the farm accustomed to look at distant objects, the herdsman with his droves and flocks, the sharp-shooters picking off the cannoniers, the colored children watching the flights of birds till lost as specks on the sky, all these teach the educability of the eye and that it is subject to law. Non-use then has impaired the sense of sight. Abuse in schools, as will be presently shown, is working sad havoc on the pupils' eyes, but even then it must be viewed as an afterthought.

Schools and school-houses are eye-traps, owing to the mode of management in them, yet there are exceptional cases which it would be manifestly unjust to include in the general statement. As it is, year after year natural conditions are violated, till the alarming extent of the disease proclaims in arithmetical arguments the amount of damage done.

In visiting the schools of St. Louis, Cincinnati and Boston—these are chosen as representative cities—I was surprised at the little use made of the blackboards. It was a matter of astonishment, and I ventured on several occasions to ask for what purposes the boards were used. Some rooms visited in the month of May had pictures on the boards drawn the June before. These pictures were for ornamentation, and were on the boards where the pupils ought to work daily. The pupils recited generally from their books or read their lessons from slate or paper. And in the more advanced classes —in the high school department—the rule, so far as I could see and comprehend it, was to send one pupil only to the board at the same time, while the others figured on slates or paper, as directed by the teacher. So many boys and girls wore glasses in their classes that verily I thought it a fashionable indication of respectability.

Summing up the results of the blackboard work in the schools of this class, it is forcibly expressed in legal parlance, thus: "Brains versus Chalk." But the proper form, however, is: "Brains and Chalk make the successful school teacher," and this emphatically embodies the kernel of truth upon which all teaching depends.

Owing to the limitations thus imposed upon school work the pupils are forced to work at a great disadvantage, the same muscles of the eyes for hours are kept in a constant tension, and the exercises are not varied to give relief or to counterbalance the undue strain. There is a path of safety and lies in the direction of variety. The board must be used more frequently. The pupils must put aside their books whenever practicable, work at the board, and during explanations scan the exercises on the board across the room. Calisthenic exercises in looking at distant objects will, in a few years, be a daily drill. By introducing variety in work and exercise the pupils' eyes will be injured but little.

Near sight is seldom found after sixteen or eighteen years of age, hence it is confined chiefly to those who have been students from early life. Seamstresses, watch makers, lawyers, engravers, &c., show a small per cent. compared to the studious. Their eyes were not distorted in early life, hence their freedom from it in old age. According to the theory now advanced there would be less near sight in new countries than in old; less in smaller cities than in large ones; less in prairie countries than in timbered; less in those who exercise their eyesight on distant objects than those who do not, and coming down to Kansas City, less in Lincoln, Woodland and Morse schools than in the other schools; less in proportion to the school population here than in St. Louis, Chicago and New York.

The report of the colored schools confirms this view. The range of vision of those children had not been shut in. They have inherited no flabbiness of tissues as in the case of the less fortunate white children, and besides the negroes have enormous curiosity which they seek to gratify at all ranges; and further, the occupations of this race have not been such as to superinduce the disease.

In conclusion, I would suggest the propriety of having medical experts examine and report on the schools of the city.

There are certain reasons why such a report would be desirable. In the first place, it would give data for solving the educational problem, and since the schools of Kansas City do more blackboard work than any other city in proportion to the enrollment, that would be a new factor, and third, it would prove or disprove the predictions in this paper.

ELECTRO-MAGNETIC QUACKERY.

In this last quarter of the nineteenth century we are accustomed, and with good reason, to believe the reign of superstition at an end. It is true that the Astronomer-Royal still receives an occasional communication from some love-lorn maidservant, asking him the lowest "figure" at which he can work the stars in her behalf, or from some alarmed countryman begging him to arrange the spheres into a conjunction favorable to his cows' disorder; but such exceptional cases are very rare, even amongst the most illiterate classes of England, and other civilized countries. The business of the witch has become extinct, and fortune-telling is punished by imprisonment. Supernaturalism has given place to science, and the spells of magic to the reign of law. But although the witch no longer exists, and the fortune-teller is dragged to jail, the crop of charlatans who prey upon the ignorant and credulous is not thereby diminished. The snake is scotched, but not killed; and the ancient Necromancy comes forth in a bran new skin as Quackery.

From their marvellous results and occult effects, electricity and magnetism are marked out as the instruments of the quack. We are, of course, far from wishing to imply that electricity has not proved itself a serviceable agent in medicine and surgery, and that there are not further triumphs in store for it as a healer. We wish here to deal, not with its legitimate practice by the faculty, but with open and manifest quackery.

Of the hundreds of pamphlets and advertisements circulated throughout the country to set forth the wonderful virtues of electric and magnetic curatives, on the "gentle current" principle, it is easy to recognize certain general features. They are usually headed by some striking motto, such as "Electricity is life" (a statement, by the way, which practical electricians may be inclined to call in question in these dull times); and garnished by bar magnets radiating "lines of force" in the most refreshing and stimulating manner, but in curves, which we need hardly say, were never drawn by Faraday. The various curative systems are distinguished by such names as "Polymagnetica," "Skeuasma," "Amynterion," "Magnetine"—titles which at once satisfy the prevailing taste for classical terminology in new inventions, and lend a foreign air pleasing to the fancy, like the Circassian dress in which Mr. Maskeyline clothes his automaton "Psycho," or the Italian and Mexican pseudonyms frequently adopted by trapezists. Sometimes the author of a pamphlet rises with the glory of his theme, the "Skeuasma" or the "Amynterion," into a true state of what Prof. Clifford would call "Cosmic Emotion," and blends poetry with his science. "Electricity," says one inspired writer, in treating of the "Magnetic Spine Band" and "Knee Cap," "electricity is the prime factor in chemical action, and in all atmospheric changes; it influences the production and growth of plants, and is essential to the life of every living thing. Where, indeed, is this subtle and powerful, though invisible agent, not at work? It pervades universal nature, and may be said to hold the Universe in its grasp. It unites one particle of matter to another, binds world to world and system to system. * * It deposits the precious metal in the veins of the rock, gives its beautiful symmetrical form to the crystal, and paints the flowers of the field; and, while it awes us in the flashing lightning and crashing thunder, lights up the gentle Aurora Borealis in our winter evening sky."

We have before us as we write a few of these pamphlets and advertisements. There is, for example, the "most marvellous half-crowns-worth in the world, the Electric Star," which is to be worn on the chest or spine over one garment. "The warmth of the body will be sufficient to excite the current, which should not be felt or but very slightly. If, however, the current be too strong, it must be muffled with an extra thickness of flannel, which changes its action to a 'quantity current' (less intensity)." This beneficent star is to be obtained at the railway stations. The magnetic system of cure, of which there are several varieties before us, are all based on the simple fact of carrying a magnet on the person. These magnets are made up into belts, spine bands, gloves, necklets, &c., for local application to the affected part. They are an almost infallible remedy for the whole gamut of human ailments from teething and whooping cough to gout and paralysis. The physical cause of the curative powers of magnetism is not far to seek. We are told in one of these pamphlets that "it is one of the most clearly demonstrated truths of science that magnetism is one of the forms of electricity; and that magnetism as easily and naturally becomes electricity, when absorbed by the living forces of the human frame, as water becomes vapor or steam by the absorption of heat. The human frame, moreover, absorbs magnetism when brought into connection with it, as easily and naturally as the plant absorbs nourishment from the soil in which it grows. * * Magnetic currents entering the human frame, are absorbed by the blood which carries in it a large portion of iron, and (in the arteries) also of oxygen, both of them are highly magnetic. As they circulate in the body, therefore, they answer the same purpose as the coils of wire in the magneto-electric machine. They attract and absorb the magnetism. The magnetism thus drawn by them into the blood, becomes an electric current in the blood, increasing its vitality and thus conveying fresh life and energy to every part of the frame." A remedy like this which renovates the blood itself cannot fail to be very comprehensive in its efficacy. As an instance of the kind of infirmities to which it is applicable besides all the principal diseases, we give another quotation: "Try a magnetic pad on a child that is restless and fretful during the night, and the relief experienced will soon speak for the value of the remedy. Persons in good health, but exposed to infection, or constitutionally liable to forms of disease, could hardly fail to find themselves secured by wearing a magnetic belt or spine band, accompanied by the daily use of the magnetic friction glove. So with others who would probably say they are in good health, but who are liable to depression of spirits. * * Few sufferers need despair of obtaining relief."

The fictitious properties of these magnetic appliances are not without the support of many testimonials some of which are from clergymen. If these published recommendations are authentic we can only wonder at the extraordinary power of faith as a healing agent.

In one of the pamphlets attention is drawn to the "Magnetic Pavement," for the prevention and cure of disease in horses (we presume the magnetic power of this wonderful invention acting on the iron shoes of the horses would not be sufficient to fix them immovably in their stalls), oxen, sheep, &c. Surely the height of absurdity is here reached.

The examples we have given will show that it is no phantom we are attacking, but a wide-spread and flourishing system. While the fortune-teller, the public spiritualist, and the card sharper are dragged to justice, the plausible brood, who in this way delude the simple and the poor, are left at liberty and even protected in their evil practices by Her Majesty's patent laws. Their day, however, is happily drawing to a close. A true education will remove the ignorance necessary to their subsistence. The next generation, we trust, will kill the snake outright, and bury it in that Limbo, to which sooner or later, all Quackery must come.--*London Telegraphic Journal.*

THE DANGERS OF ANÆSTHETICS.

BY A. H. TREGO, D. D. S., KANSAS CITY, MO.

A recent fatal result from use of Nitrous Oxide Gas has caused considerable excitement and exaggerated comments. To say the least of it, it is preposterous for any one to assert that there is "no danger" in depriving the human organism of all sensibility by use of anæsthetics. It is claimed that fewer deaths have resulted from "gas" than from chloroform or ether. This is explained by the fact that fewer persons (in proportion) have been made insensible by its use It is almost impossible to get a nervous patient, or one with weak lungs, to breathe sufficiently rapid to become entirely anæsthetized by nitrous oxide. Professor Zeigler says the effect of nitrous oxide gas is "the point beyond superlative exhilaration." For instance, a horse is trained to trot at the rate of 2:18, you urge him to that point and by further urging he breaks, becomes demoralized and insensible to outward influences. Horses have died on the track from superlative exhilaration.

The fatal cases from nitrous oxide seem to have been patients who were susceptible to sudden death from any unusual excitement—as fright, over-exertion or the anxiety natural to having a dreaded operation performed. The anæsthetic simply drove the circulation to a point beyond its normal capacity. This condition of exhilaration applies more especially to gas, as with chloroform and ether the effect is mere narcosis. More bad effects result from gas than from other agents, in proportion, on account, undoubtedly, of its supposed safety and of unscrupulous operators. In larger cities the gas business is done where they make extracting teeth a specialty, and patients are rushed through the mill regardless of health, nerves or condition. In smaller towns it is impracticable and non-paying, and the gas is liable to be stale or impure. Under either circumstance it is excessively uncleanly to inhale from a bag that others have exhaled their fœtid breath into.

Only a small portion of gas is taken up by the lungs at each inhalation, and all that is exhaled is carbonic acid gas, which soon poisons all that is in the bag. Hence, it is not improper to infer that the patient, when insensible, is as near asphyxia as anæsthesis.

Syncope is a misnomer for the alarming symptoms produced by ether. When death results from inhaling ether the heart continues to beat several minutes after respiration has ceased, thereby giving due warning of danger and making ether comparatively safe.

Loud breathing (snoring) proceeds from inertia of the palate, and should be carefully watched. If it stop suddenly stop the ether and apply restoratives.

Chloroform is more volatile, more powerful, and the danger exists in sudden action upon the heart. Experienced, unhesitating operators will readily detect danger when the patient has taken a few inhalations.

The colleges and hospitals have adopted as a standard, one part chloroform to two or three of ether, the mixture being more active and more readily thrown off. There is no authentic case where any patient has died from anæsthesis by the use of this mixture. There is danger that a cheap and supposed-to-be-safe anæsthetic will be introduced, in which case America is liable to become a toothless community.

Moral—Don't allow your teeth to require extracting.

GEOLOGY AND MINERALOGY.

THE STE. GENEVIEVE COUNTY COPPER MINES.

The copper mines described at length below are now becoming quite widely known, consequent on shipment East of their ores and the recent construction of a copper furnace at Ste. Genevieve, in which the copper ore is now reduced to the condition of black copper, and in that condition shipped eastward for refinement.

St. Louis, Mo., June 8, 1877.

Messrs. Rozier, Harris & Co., Ste. Genevieve, Mo.:

Gentlemen—I herewith submit my report upon the "copper lands" belonging to Messrs. Rozier, Harris & Co.:

The property is situated in the county of Ste. Genevieve, State of Missouri, in and about ten miles west of the town of Ste. Genevieve, which is on the Mississippi river, sixty miles below St. Louis.

Topography.—The county is undulating, with hills from 150 to 200 feet in height, with here and there valleys sufficiently wide for agricultural purposes. The limestone constituting the substructure of the hills is covered with a deep soil; but here and there the soil has been carried away by erosion, laying bare the rock, and in many places leaving a seam of copper ore exposed.

Geology—The geology of the copper ore district belongs to the Upper Silurian formation which extends far to the West and reaches within a few miles of the river on the East, at which point the "Carboniferous system" occupies the intervening district to the river. The copper ore occurs in three, possibly four, distinct beds.

The Harris Mine.—The copper ore at this point occurs in three beds; the lower bed is situated far down the hillside, and as yet is not developed; the middle bed which is by far the most important, occurs on or about the 75 feet contour line of the hill; this belt lies horizontal, and between the layers of limestone. Immediately below the ore bed is a stratum of quartz or flint of several inches in thickness; then the hard, dense limestone. Immediately overlying the ore bed is another thin stratum of flint, and then the Silurian limestone, which extends to the top of the hill. Near the summit of the hill the third ore bed occurs, which, like the first, is undeveloped; but both the first and third promise upon further development to equal in quantity and quality the middle deposit of ore.

As the three deposits are so similar in their character, both mineralogically and geographically, a description of one will answer for the others: The ore bed proper is a horizontal stratum between the limestone beds, undulating with them and partaking of their folds, and though the folds are continually changing, they remain almost at a uniform level. The ore bed changes in thickness from six or eight inches to several feet; and on measuring the beds at a number of points, I consider a foot in thickness a low average. Near the surface in the clay and on the exposed rocks the ore has to a great extent been transformed into green and blue carbonates; but as the hill is penetrated the sulphuret occurs, mixed with carbonates and red oxides; and at a distance of 100 feet the carbonate gradually diminished, being replaced by red oxide with considerable sulphuret. The experience at every point has been that the ore increases in richness and quantity as the hill is penetrated, not unfrequently being several feet in thickness of almost pure red oxide and sulphuret.

The mines are invariably free of water, no trouble being experienced except immediately after heavy rains; and this trouble can soon be obviated as the mines admit of a fine system of drainage, as tunnels can be run into the hillsides, draining off the waters into the valleys below.

The percentage of the ore varies very widely, according to the character of the ore. Two green carbonates, mixed with silica, respectively gave 13.72 per cent. and 17.69 per cent. One specimen of green carbonate, 28.51 per cent. A number of red oxides ranging between 33 per cent. and 35 per cent. One of pure green carbonate gave 40.28 per cent. The average selected ores range from 20 per cent. to 30 per cent. A very large amount of ore, probably 1,000 tons, is on hand, averaging 10 per cent., not shipped, being considered too low a grade; but with proper handling could be smelted at a profit.

The Chicago Mine.—The Chicago mine is situated on the same hill, and is almost identical in every respect with the Harris mine; in fact, the above description answers both, and I had both in my mind when writing this report. This mine is much farther developed than the Harris mine, showing the same character of ore.

A number of drifts have been run into the hill to depths ranging from 50 to 165 feet, the ore gradually increasing in richness and quantity as the hill is penetrated; about 300 feet of drifts have been run, averaging a height of 5½ feet and a width of 5 feet.

The character of the ore and rock renders mining very easy; and the mixture of the carbonates, sulphurets and oxides are such as to make them very desirable for smelting. These ores are bought at a furnace at Ste. Genevieve, the price paid being according to the percentage of the copper contained in the ore, ranging from $25 to $100 per ton, delivered in Ste. Genevieve. To mine and deliver the ore, including all expenses, it costs about $25 per ton.

The roads are in fair order; the road bed being partly of rock, but principally of red clay. With a small outlay of money and work these roads could be put in a good condition. At present a ton to a two-horse team is a fair load.

The property consists of 80 acres (in fee simple) and the mining lease for 20 years, on about 250 acres of land, the whole tract being contained in hill described, and no doubt underlaid by at least three, and probably four, ore beds.

From the large quantity of ore already proved to exist in the hill by numerous tunnels and shafts, the richness of the ores, the readiness with which they are smelted, the facilities of transportation to market, and the great demand for the ores, the property is of great value.

Very Respectfully, etc., JAS. R. GAGE.

THE GEOLOGICAL RELATIONS OF THE ATMOSPHERE.

The gaseous envelope which surrounds our globe plays a very considerable part in the chemical changes ever going on in rock formations, whether actually at the surface—as in what is called the "weathering of rocks"—or in the less apparent, but perhaps more powerful, action carried on below the surface. In a late number of the *Quarterly Journal of Science*, Edward

T. Hardman, F. C. S., has a very exhaustive paper on "The Atmosphere Considered in its Geological Relations," from which we extract the following interesting facts:

Perfectly pure water has a very appreciable solvent effect on rocks. which is immensely augmented when it is chemically charged with carbonic acid, oxygen, nitric acid, and other matters derived directly or indirectly from the atmosphere. But while on the one hand the influence of the atmosphere disintegrates and destroys rock masses, on the other it is mighty in building them up. Without the small percentage of carbonic acid contained in the air there could be no vegetation, and there would be none of the coal beds which form such important members of our rock formations. The immense masses of limestone found everywhere, and the coral reef of the present day, must owe their being indirectly to the carbonic acid of former atmospheres. A drop of rain water absorbs a trace of carbonic acid from the atmosphere, falls on a rock containing lime in some form, dissolves the lime as bicarbonate, carries it down to the ocean, and finally gives it up to become part of the skeleton of a coral or mollusc, which in its turn may form a portion of an immense mass of limestone rock.

The bulk of the atmosphere is made up of oxygen and nitrogen, but these do not take so active shares in geological matters as the almost infinitesimal trace of carbonic acid present. The amount ranges from 3 to 10 volumes in 10,000 volumes of air. The principal sources of increase are. volcanic and other subterranean exhalations; respiration of animals; combustion of fuel and vegetable decay.

The series of rock-metamorphisms due to the simple absorption of carbonic acid by a plant is very interesting. The carbon is assimilated by the plant, and it dies and becomes thus a part of a coal bed or lies embedded in sediment of some kind. Decomposition sets in; and if there be a reducible compound near it, chemical changes result. If the strata contains sulphate of iron, it is reduced to sulphide, commonly known as iron pyrites or false gold. The reduction is effected by the carbon of the plant abstracting the oxygen from the sulphate. The resulting carbonic acid either is taken up by percolating water and penetrates farther into the heart of the rock, effecting new changes, or it finds its way to the surface through some crevice, or by aid of a mineral spring, and once more mingles with the atmosphere, to be perhaps again absorbed by vegetation and pass through a similar round of changes afresh. In many cases the action of the carbonic acid changes a metallic ore from an insoluble to a soluble compound, thus reducing the ancient crystalline rocks. The metals carried away by streams were deposited along their beds, and valuable beds of ore were formed.

The atmosphere in the carboniferous age contained a much larger portion of carbonic acid. This has been gradually absorbed into the earth, until the amount stored in the earth is estimated at 6,620 times as much as there is in the atmosphere, although the latter contains 1,250,000,000,000 tons of carbon. All animal carbon is derived from the atmosphere. Say a tiger dines off a cow, the carbon and nitrogen of her flesh have been obtained from vegetation, which in turn extracted them from the air; so that we have a kind of physiological "House that Jack built," "This is the Tiger that ate the Cow that devoured the Grass that absorbed the Carbon," etc.

Any considerable difference in the volume of carbonic acid must result in diminution of animal life. Very little above the ordinary standard carbonic acid in air becomes a deadly poison to all warm-blooded animals. If diminished vegetable life would languish, graminivorous animals would die of starvation, and finally the carnivora, being obliged to prey upon each other, would of course become extinct. The result would be a completely barren and desolate planet, perhaps in some degree resembling the moon.

Oxygen is the next in importance as a geological agent. Percolating in rocks, dissolved in rain water, it quickly reacts on all oxidizable substances. Carbonates and protosalts are converted to peroxides; sulphides are changed into sulphates, and sometimes alums are formed.

Carbon and oxygen are thus antagonistic in their action on rocks and minerals, and are thus keeping up a circulation between the earth and the air. The carbon always reduces the oxides, and the oxygen replaces the carbonic acid of carbonates with the same inveteracy.

The ammonia existing in the air is absorbed by plants, and by their decomposition forms nitrates. "And now," Mr. Hardman says in conclusion, "it will be seen what an all-powerful agent the atmosphere we breathe is. Without its aid we should know never a stratified formation, and would simply form a ball of truly primitive rock. We should have no coal, no metalliferous deposits, no rivers or seas, and no rain—consequently no denudation by rain and rivers—for the vapor of waters could not ascend into empty space. We should have—but, last and worst of all, there would be no "we." Life would be impossible, and the earth would finally degenerate into a pale-faced moon." That this is probably her mission cannot be denied; and probably before Saturn and Jupiter have cooled down to a habitable temperature, the senescent earth will roll through space—cold, void, and airless.—*Scientific American.*

SHIPPING LEAD TO CHINA.

The Belgic, which left San Francisco for China and Japan October 23d, as part of her cargo, had 83,852 pounds of lead. If this amount of lead was raw, which it probably was, unless to fill an order, it will hardly prove a better speculation than the large shipments made in the beginning of the year. As we stated over a month ago, China is not a large consumer of lead in any other form than as tea-lead. The Richmond Company at Eureka, Nev., is the largest Pacific coast producer of lead, and to that company, the conversion of a portion of its immense production into tea-lead, the benefit would be vast. Since the freights eastward are enormously high, by going westward the railroad distance is short; the meanwhile the lead is going in a direct line toward a market which can by care be made to absorb 8,000 to 12,000 tons annually.

We have taken the trouble to visit one of our largest St. Louis sheet-lead manufactories, and as well have ascertained the cost of suitable machinery, aside from the propelling power and buildings of a complete plant for the production of twenty tons of tea-lead every 24 hours: for $2,000 a first class tea-lead mill can be built, having steel rolls eight inches in diameter and three feet long, ground to absolute truth on their faces, with the carrier rollers on friction bearings; the sheets to be finished three on a final pass.

The question has arisen as to the quality and purity of the lead demand for the tea trade. We have handled many tons of tea-lead which we have converted into other forms, where it was assumed that considerable purity was required. No extraordinary quality of fineness is to be found in it. A freedom from zinc is observable. There is, however, in the white-colored tea-lead, small quantities, both of tin and arsenic, neither of which can be hurtful, when the case is kept as free from damp exhalations of water as the preservation of the chest's contents demand.

We have mentioned as favorably situated, for the production of tea-lead, the Richmond Company of Eureka. The enormous production of that company can seriously affect the Eastern market. It is an Anglo-American enterprise, and would not find such violent English competition in the markets of China and Japan as would the North Beach or Eureka Company article. British parties would actually be interested and aid in the establishment of a wide spread demand. Even the tea-producing provinces of India could in time be thus made serviceable markets.

In a future article we will indicate a popular and general use in architecture for lead, wherein its economy and superiority over wood, slate, iron, tin and coopper will be shown. It is now a proper time to devise permanent uses and applications for lead, to prevent the possibility of its ever again glutting the market or falling below five cents a pound. Well directed effort will make both the task and the accomplishment comparatively easy. —*Mines, Metals and Arts.*

THE WONDERFUL FOSSIL BEDS OF OREGON.

A correspondent of the Eugene City, (Oregon) *Guard* gives the following account of a visit made last June by himself and another person to the fossil beds of Lake county, that State: Silver Lake and Summer Lake lie on the confines of the desert, by the crossing of which much suffering was experienced by the early Oregon pioneers. . Silver Lake is encompassed by "rim-rock," except on the northwest. On the east there is a gap which leads into a basin nearly circular, and which is probably 30 miles in diameter. This basin is surrounded by rim-rock on the south, southwest and west, rising to the height of several hundred feet, with occasional breaks or canons, sloping into the basin. On the north and northeast of the basin the ascent is more gradual, but at a distance presenting an uninterrupted barrier. The surface of this basin is comparatively level, being subject, however, to slight inequalities in the form of hillocks or low ridges rising but a few feet.

The soil, if we may venture to call it soil, seems to be composed of light sand and volcanic ash, with a percentage of vegetable mould, into which a horse will frequently sink to his fetlocks. Near the center of this basin, and about 18 miles from Silver Lake, in a northeast direction, is "Christmas Lake;" 8 miles from Christmas Lake, in the same direction, and apparently on the same level, are Fossil Lakes. About 5 miles further on, in the same direction, are two springs of tolerably good water. These springs are about half a mile apart. I heard the most northerly called Duncan's Spring, and we called the other Mound Spring. The rocks about Silver Lake and Summer Lake, where stratified, appear to dip to the north.

From 20 to 40 miles in a northwest direction from the Fossil Lakes, set in the lava mountains or rather mountains of lava. It would seem that these fossil remains might have remained buried from 4 to 10 feet in the earth, and, therefore, unknown to the prying eye of the antiquarian, but for the action of the wind. There seems to be a constant current of wind from the southwest. All that space where the bones are found appears to be scooped out to the depth of several feet, and carried, some of it, to a distance of from 5 to 10 miles, where it is piled up in every conceivable form, evidently by the action of the wind; conclusive evidence of this is found in the numerous little mounds still remaining, and able to resist the action of the wind by the aid of the roots of some more vigorous bunch of sage or greasewood. These mounds present a beautiful example of stratified formation, often 5 or 6 strata, ranging from 3 to 8 inches in thickness, very clearly marked. On the lower levels of this excavation are where the fossils are found. We found fossil bones of the elephant, camel, horse, and elk or reindeer, the horse being much more abundant than either of the others, but all being so clearly marked as to leave no doubt of their identity. There were other bones, apparently of large animals, but your correspondent was unable to name the animal they once belonged to. Among the fossils found the smaller quadrupeds had a representation; bones answering in size to the fox and wolf were found, also others answering to the sheep or goat in size and appearance. Remains of birds were very plentiful, some very large, others quite small. Waders, swimmers, scratchers, and probably climbers, were recognized. The vertebræ or backbones of fish, or some other animal with a backbone like the fish, are found in great plenty; also bones like nothing I ever saw before, therefore, I will not undertake to describe them.

The fossil remains lie scattered over the earth for a distance of 4 or 5 miles in the direction of northeast and southwest, the strip being probably a mile wide. Near the southwest end of the deposit are two small lakes or

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ponds, highly impregnated with alkali, the water having a milky appearance, with a disagreeable taste and smell. I have presented to Professor Thomas Condon, of the State University, to whom I was largely indebted for valuable suggestions as to the manner of selecting and packing specimens, the most of my find, retaining but few duplicates myself.

MECHANICS AND ENGINEERING.

LONGEST BRIDGE IN THE WORLD.

The longest railroad bridge in the world was opened for public travel near Dundee, Scotland, on Tuesday, September 25. The structure thus opened spans the estuary of the Tay at a point almost two miles in width. It has been constructed for the purpose of affording facilities for the more convenient conduct of the traffic of the North British Railway Company. Hitherto the North British Railway Company have had to carry their traffic across the Tay by means of a ferry, and this method was not only expensive, but exceedingly slow. Accordingly, their engineer, Mr. Bouch, prepared the plans of the bridge which has now been completed. Parliamentary sanction was obtained in 1870, the bridge being constructed as a separate undertaking, with a capital of $1,750,000.

The contract for the work was obtained in May, 1871, and the foundation stone was laid in the land abutment on the south side on the 22d of July of the same year. The bridge begins about a mile and a half above Newport, on the south side of the river, where the depth of water at high spring tides is 45 feet, the velocity of the current reaching occasionally five knots an hour. To bridge this formidable stretch of water, the engineer planned a bridge of 85 spans, varying in length from 67 feet to 245 feet—those of the largest size, to the number of 13, being placed over the navigable part of the river. In this central section, where it was necessary to provide for the passage of such shipping as frequents the ports of Newburg and Perth, the bridge has a clear height of 88 feet above high water, from which it slopes down to the Fife side with a gradient of 1 in 356, and toward the Dundee side, where it takes a curve to the eastward, in order the more conveniently to join the land line, with a gradient of 1 in 73. Cylinders of iron and brickwork, with a diameter of 9½ feet, built on shore in such lengths as would reach from the rock on which they were intended to rest to a point above low water level, each consisting of a cast-iron shell with a lining of brickwork set in Portland cement, leaving inside a central shaft three and a half feet in diameter, through which the workmen might pass up and down, were connected by means of a wall of brickwork about five feet wide, thus placing a space of twelve feet between their centers. The whole being then made fast to a system of strong iron girders, barges were introduced at low water underneath the girders so that when the tide rose, the ponderous mass, weighing, it might be, as much as 120 tons, was lifted bodily, and quietly floated out into the river. Having been towed out to the site of the intended pier, the cylinders were lowered by hydraulic apparatus till they rested on the river bottom. Workmen then descended the internal shafts, excavated the material from beneath the cylinders, and so caused them gradually to sink until they reached the rock, in which a level bed was cut for their permanent resting place; but after the work had been in progress for some time it was found that the rock suddenly shelved away to a great depth under beds of clay, gravel and sand. It therefore became impracticable to sink the piers to that foundation, and a new method had to be introduced. The weight of the pier was lightened by substituting in the upper works iron columns for solid brick, while the adoption for each pier of a single oval cylinder measuring $23\frac{1}{2}$ feet by $13\frac{1}{2}$ feet secured a larger bearing than had previously been obtained with two smaller ones. The outer casing was of malleable instead of cast iron. When the large masses were prepared they were floated out and lowered to the river bottom, the sand at the base being removed by a pump invented by one of the assistant engineers. By the working of the pump a large cavity was speedily formed under the cylinder, and the huge mass of metal sunk into it by its own weight, reaching to a depth of about 18 feet below the bed of the river. The interior of the cylinder was afterwards filled to the top with concrete, and the upper part, so far as it stood above the bottom of the river, was next removed, thus leaving an ample platform of artificial rock for the reception of the superstructure, which consisted in the first instance of brickwork in the form of an elongated hexagon, measuring 20 feet by 10 feet, and placed with its greater length in the direction of the current. This part of the pier was likewise put together on shore, and floated out between barges in a length of about 20 feet, being sufficient, when placed upon the cylinder, to reach above low-water mark. From the low-water level the pier was formed of solid brickwork, built in the ordinary way by workmen brought alongside as the state of the tide would permit; and at high-water mark four courses of stone, of an aggregate thickness of four or five feet, finished off this portion of the work. The piers of fourteen spans were founded in this way, the upper works being formed of iron columns of twelve and fifteen inches diameter.

When the piers had been brought to the necessary height, the girders, measuring 245 feet in length and weighing 190 tons for each span, were towed out and deposited. The raising of the girders when the piers had been completed was carried on in lifts of 20 feet at a time by hydraulic apparatus. Two girders, connected by tranverse braces, go to each span, the depths varying according to the width of the space to be crossed. The length of the span diminishes in going toward the shores, on either side of the navigable channel, the depth of the girders being correspondingly decreased, the minimum being 12 feet. To provide for expansion by heat, which will amount to something like seven feet in the whole length of the bridge, the girders have been adjusted to the piers to allow a certain amount of free play. The bridge has been calculated for a rolling load of one and a half tons to the foot run. Such a burden is more than could be brought upon any span by filling its whole length with loaded freight cars; no part of the bridge would have to undergo a strain of more than four tons to the square inch, and when it is borne in mind that the iron is actually capable of sustaining a strain of twenty-one tons to the square inch, it will be seen that there is an ample margin of surplus strength.

COLORING OF METALS.

Metals may be colored quickly and cheaply by forming on their surface a coating of a thin film of a sulphide. In five minutes brass articles may be coated with any color, varying from gold to copper red, then to carmine, dark red, and from light aniline blue to a blue-white, like sulphide of lead, and at last a reddish white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colors possess a very good lustre, and if the articles to be colored have been previously thoroughly cleaned by means of acids and alkalies, they adhere so firmly that they may be operated upon by the polishing steel. To prepare the solution, dissolve one half ounce of hyposulphite of soda in one pound of water, and add one half ounce of acetate of lead dissolved in half pound of water. When this clear solution is heated to from 190 deg. to 200 deg. Fah., it decomposes slowly, and precipitates sulphide of lead in brown flakes. If metal be now present, a part of the sulphide of lead is deposited thereon, and, according to the thickness of the deposited sulphide of lead, the above colors are produced. To produce an even coloring, the articles must be evenly heated. Iron treated with this solution takes a steel-blue color; zinc, a brown color; in the case of copper objects, the first gold color does not appear; lead and zinc are entirely indifferent. If, instead of the acetate of lead, an equal weight of sulphuric acid is added to the hyposulphite of soda, and the process carried on as before, the brass is covered with a very beautiful red, which is followed by a green (which is not in the first scale of colors mentioned above) and changes finally to a splendid brown with green and red iris glitter. This last is, according to the *American Art Journal*, a very durable coating, and may find special attention in the manufactures, especially as some of the others are not very permanent. Very beautiful marble designs can be produced by using a lead solution, thickened with gum tragacanth on brass which has been heated to 210 deg. Far., and is afterwards treated by the usual solution of sulphide of lead. The solution may be used several times.—*Van Nostrand's Engineering Magazine.*

SOLUBLE GLASS.

The silicates of soda and potash differ from the other silicates grouped under the general name of glass in being soluble in water; hence they are known as soluble glass, water-glass, liquid quartz, etc. While ordinary glass has been known from very ancient times, these peculair compounds are quite new to us, having been accidentally discovered by the late Prof. Fuchs of Munich, in the year 1818, while experimenting with a view to the preparation of pure silica. In 1823, when the Munich theatre was rebuilding after its destruction by fire, the Bavarian government appointed a scientific commission to consider by what means the woodwork and stage fixtures might be rendered incombustible; and Fuchs, in connection with Pettenkofer, after careful investigation, settled upon soluble glass as the best agent for the purpose. It has since been much used in this way, though for textile fabrics the tungstate of soda has come to be preferred. In applying soluble glass it is necessary to begin with a weak solution, and to let the first coat dry thoroughly before putting on a second, which may be more concentrated. A wash of lime is sometimes used between the two coats.

When the soluble glass is applied to surfaces of plaster and limestone, an interesting chemical reaction takes place, resulting in the formation of silicate of lime. A vitreous surface is thus produced, impervious to moisture and unaffected by atmospheric agents. Soluble glass is also used as a vehicle for mineral colors in a kind of fresco-painting, known as *stereochromy*, which is intended to withstand exposure to the weather. The famous frescoes by Kaulbach in the Museum of Berlin were done in this way. It is also coming to be employed for preparing paints for ordinary use, and there are factories exclusively devoted to the manufacture of this class of pigments.

One method of making artificial stone is by moistening fine sand with a solution of silicate of soda, pressing the mixture into mould, drying it and exposing it to a high temperature. The silicate fuses and cements the grains together into a mass resembling sandstone. Any desired color may be imparted to the stone by the admixture of metallic oxides previous to the moulding process. Thousands of tons of the silicate are consumed for this purpose in England.

Another important application of soluble glass is in calico-printing, where it is now extensively used as a mordant. It is even more in demand in soap-making, for which it has advantages over resin, on account of its alkaline character. It also enters into the composition of fire-proof cements for stoves and other iron-work, and especially for putting up iron fronts for buildings.

In this brief notice we bave mentioned only the leading uses of this valuable substance. The demand for it in the arts is daily increasing, and it is probable that its commercial and industrial applications are destined to be immensely extended in the future.—*Boston Journal of Chemistry.*

HOUSEHOLD ECONOMY.

ANCIENT COOKERY.

Very often is a history locked up in a word. It is certain that the words in which our ancestors expressed their thoughts come down to us and help to influence our thoughts. The structure of our language has been greatly influenced by the ancient languages, and the Greek and Roman classics are considered so important that they are made text-books in our schools. Is it not possible that our cookery may also have the same stamp, and that as unconsciously as we press into service the classic thought and the classic word, we may also follow the classic taste in classic recipe? As our words have come down to us in mother tongue from generation to generation, as the son speaks like his sire, so the daughter cooks like her mother, using styles and condiments, dishes and recipes, that her mother used before her.

Where did they originate? So far as our observation goes, women are not given to devising new dishes. It is true that changes come, perhaps through accident, perhaps through stress of circumstances, but often with as little thought as might be given to the gradual change of a word. But if classical literature has had an important influence on our modes of thought, is it not much more probable that classical cookery may have had quite as important an influence on our modes of living, and through them upon our health?

We have reason to believe that primeval cookery was exceedingly simple. Our first glimpse of it is in the patriarchial tent of Abraham, where Sarah kneaded "fine meal" and made cakes upon the hearth, which were served with the dressed calf and butter and milk. For aught we can see in the text, the patriarch himself cooked the calf, and if he did so, he was justified by noble company. His own grandson is represented as making a pottage so seductive as to beguile his brother of the birthright. The heroes of Homer did their own cooking. Achilles turned the spit. Their exact methods of cooking are not very carefully recorded, and it is probable that the women did the most of the culinary work, yet the mention of many such circumstances seems to indicate that it was done with very little art and upon occasion by those who needed it. Roasting meat before the fire or seething it in a pot, and baking cakes in the hot ashes on the hearth were probably for ages the highest achievements in that line—wholesome cookery indeed! Shall we say that it were better if we had never departed therefrom? Is it true that man in this respect, in his best estate, is a barbarian, or shall we take the results of a long experience in waywardness and learn how to come back to nature intelligently and permanently?

The first gross violation of nature we find in the leaven which apparently the Hebrews learned to use among the Egyptians. This was simply sour dough, usually kept by reserving a piece of the bread-dough until the next baking. This addition excited fermentation in the mass more readily than if left to sour of its own accord. With the increasing fineness of their flour had come the need of something to make it light, and as they had not our ovens or gem-pans or our other intelligent devices for making bread at once light and wholesome, they accepted this chance device of leaven and used it for centuries; indeed, it is still in use. There is little doubt that its impure character was partially recognized among the Hebrews, for in some of their ceremonial purifyings all leaven and all fermented articles were removed from the house.

The first traces we find of yeast are in the writings of Pliny. He says that for leaven the Roman mixed millet with sweet wine and let it ferment a year! They also employed wheat bran soaked for three days in sweet white wine and dried in the sun. Of this they diluted a certain quantity at the time of making bread, which was left to ferment in the best wheat flour and afterward mixed with the entire mass. This is our present style of "sponging," plainly enough, though the "yeast" is not so definite. Indeed, these and the following items show that the Romans at that time did not use yeast in its present form: "A dish containing two pounds of barley paste was heated until ebullition commenced. It was then put into vessels until it became sour. Very often leaven was procured from dough just made. A piece was taken from the mass and left to turn sour for subsequent use." In addition to all this, Pliny goes on to say that the Gauls and the Spaniards, after having made a drink from grain, *saved the scum* to raise dough, and that their bread was the lightest of all. Perhaps some of our readers will recognize this as having the same origin as our "brewer's yeast;" to others, who never before looked so far, it will unfold the not over-clear origin of the first cup of yeast—the filthy scum of the decaying liquid in the brewer's vat. Verily, they did find something at last wherewith to make their bread light, but it was at a rather severe cost to its cleanliness and nutrition.

In the gratification of the palate and the fancy, the Greeks and Romans at last launched upon a mad whirl of artificiality, which delighted in outraging all laws of nature, moderation, common sense, and even decency. One hardly knows where to begin the strange list, unless, indeed, we begin with the degeneracy of aims, the grossness of greediness, and the recklessness of expense which permitted such extravagances.

Expensive eating came to be apparently the only ambition of the Roman people and their rulers. Their senators vied with each other in giving the most extravagant dinners, and their emperors took the lead to such a degree that some of them are noted only for the extent of their appetites. The Emperor Claudius sat down to table at all hours and in any place; nor did he leave the repast until distended with food and soaked with drink, and then only to sleep. When he awoke, a tickling feather relieved him of his surfeit, and he was ready to eat again.

Many of the gourmands became great adepts in the use of the feather. Vitellius used it so effectually that he could cause himself to be invited to dinner by several different senators the same day. Little he cared if it should cause their ruin; for they could not venture on such a banquet at a less expense than 400,000 sesterces ($16,000), and this was but a moderate sum. Lucullus served Cicero and Pompey with a little collation that cost $5,000, and there were three of them to eat it. How they could expend so much may be easily seen if we examine their dishes, which were little prized unless procured at great expense. They had flesh of peacocks at $40 per pair, was preferred to that of cheaper but more delicious poultry. But since many could avail themselves of peacocks, even at this price, those who would not be outdone had dishes of peacocks' brains. Another dish was composed of the tongues of singing birds. Young pigs were fed on dates; geese were fattened on figs, and their livers alone were used, being soaked in milk and honey—the forerunner of the modern *paté de foie gras.* Fish were in great demand, and those which were brought the greatest distance were the most highly esteemed. Whole fleets of ships were employed in bringing these and other dainties from abroad. Roman nobles would not unfrequently pay one hundred dollars for a single lamprey. Mullets sold as high as from seventy-five to one hundred dollars each, and it is related that Crispinus paid three hundred dollars for one weighing six pounds, and considered it cheap at that. In the reign of Tiberius three of these were sold for one thousand dollars. What, then, must be the cost of dishes composed only of the livers of these fish? Heliogabalus had upon occasion two large dishes filled with their gills only. At last the wealthy built expensive reservoirs and kept their own fish, though not with a view to economy, for they fed them with the rarest dainties. It was even said that slaves were thrown in to satiate these pets, but whether this be true or not, their sea-eels were commonly fed with veal soaked in blood. Other sorts were taken from the river just where it received the filth from the entire city.

In wonder it may well be asked what had become of the common sense and decency of human nature. We can account for these excesses and atrocities only by observing the entire departure of the people from natural rules and their utter abandonment to the artificial. Instead of studying into the nature of their materials, with a view to producing the greatest harmony in their combinations, they seem to consider it a crowning achievement if they could entirely obliterate all traces of their real nature and substitute therefor whatever was most foreign and not recognizable. Fish of various sizes were served up to resemble pork, veal, beef, or mutton, and *vice versa.* Vegetables were cooked to resemble meats, and meats disguised to resemble other substances. Eggs were served, which on being broken were found to contain fat ortolans. The cook of Louis XIV, who on Good Friday served up a dinner composed of poultry and butchers' meat, but which was really nothing but vegetables, had a good deal of the same spirit, and must have had no small amount of practice to bring about such results.

But what of the effect upon the taste? It is related of one of these old gourmands that he was seized with an invincible desire for loaches. It was in the middle of the night and they were far from the sea. He had no idea where the loaches could be obtained, but loaches he must have, and his chief cook was summoned. "Loaches, sire!" cried the man in dismay; but the command was imperious and must be obeyed. The cook was more skilfull than the noted Vatel, cook to the Prince of Caudè, who when he found that his master was to entertain the king at dinner, and there were no fish to be had, went to his room and threw himself upon his sword. The demand for loaches sent this man to his room, not to kill himself, but to study and experiment. Before long he came forth with a plate of fried loaches, irreproachable in appearance, and as to taste the gourmand declared he had never before eaten any he liked so well! And of what were they made? Of radishes, pared, cooked and seasoned. But if we admire the skill that could prepare such a dish, what must we think of the taste that judged it?

Of this taste we may judge partly by their seasonings. The following ingredients composed their sauce for crawfish: honey, vinegar, wine, garum, oil, chopped onions, pepper, alisander, carrots, cummin, dates and mustard. The following is stuffing for a crab: cummin, mint, rue, alisander, pine nuts and pepper soaked for a long time in garum, honey, vinegar and wine. The following made sauce for roebuck: pepper, parsley seed, dry onion, green rue, spikenard, honey, vinegar, garum, dates, wine and oil. The following is the entire recipe for a dish of ducks' brains: "Cook some ducks' brains and mince them very small; then place them in a saucepan with pepper, benzoin-root, garum, sweet wine and oil; add milk and eggs, and submit the whole to the action of a slow fire." The celebrated Apicius gives this dressing for roast duck: "Make a mixture of pepper, cummin, alisander, mint, stoned raisins or Damascus plums; add a little honey or myrtle wine; place it in a saucepan, cook, and then add to these substances vinegar, garum, and oil; afterward, some parsley and savory.

We find a large share of the recipes equally absurd; we select a few cakes from Apicius: "Mix pine nuts, pepper, honey, rue and cooked wine; cover with eggs well beaten; submit this mixture to a slow fire, and serve after having smeared it with honey." Again: "Make a compact mixture of honey, milk and eggs; let it cook very slowly, and serve after having sprinkled it over with pepper." Less elaborate cakes were made with cheese and rye or other kinds of flour, and sometimes with the addition of eggs and honey. Sugar they did not have, hence dates, figs and honey were their principal sweeteners, but cheese was a common ingredient of their cakes. Here is one of the most simple: "Half a pound of flour, two and a half of cheese, three ounces of honey and one egg. As soon as baked it was smeared with honey and dredged with poppy seed." It was eaten with spoons. We should hardly accept it now, either for taste or wholesomeness, though it is not quite so gross a conglomeration as the sauces already given.

It will be noticed that every one of these included garum. This was the "universal" sauce of meat cookery. Like the East Indian curry, it went into everything. We have no such universal seasoner, unless it be salt. Catsup and Worcestershire sauce, as used by some individuals, afford some illustration, only that these find their place in the caster, while the garum was usually added by the cook. In a collection of old Roman recipes now before me, of fifteen for preparing chicken, lamb and kid, twelve contain garum. Its character betrays at once the coarseness of the Roman taste and the uncleanness and artificiality of Roman food preparations. Its essential ingredients were salt and decayed fish. They "macerated the intestines of fish in water saturated with salt until putrefaction began to show itself, and then they added parsley and vinegar." "A thick garum was also frequently obtained by allowing the entrails and other parts generally thrown away to liquefy in salt." "In the time of Pliny mackerel was preferred, of which they employed either the gills or the intestines."

So if any one wishes to get a tolerable idea of the character of this famous Roman sauce, let him visit an ancient and deserted barrel of salt mackerel, in which some of the fish have been left to spoil, and secure some of the delectable brine. He will probably find it sufficiently revolting to his unaccustomed taste, without attempting to manufacture it *en regle* from the gills and intestines. That the above are not exceptionally repulsive methods of preparation will appear from further recipes. The following was in very common use: "Amatuus took very small fishes or only their entrails and threw them into a vessel with a large quantity of salt. These were exposed to the sun and long and frequently stirred. When heat had caused fermentation and the vessel contained only a kind of pulp or paste, almost liquid, a kind of willow basket was introduced, into which the garum alone could penetrate." "Although fish was generally used, the flesh of several animals was sometimes employed in the formation of garum."

Of course, this was too inexpensive to suit the taste for lavish display, and the "apogee of refinement" was secured by using the liver of the red mullet, the expensive fish we quoted above. Others again used the blood of mackerel or of the mullet, and a quart of this garum, on account of its scarcity and the care necessary for its production, cost from $15 to $20. Oeno-garum was a preparation of garum with wine and spices, and oleo-garum with oil and spices; hydro-garum, with water, etc.

"The principal elements of garum, then, were almost invariably the same —fish, salt, and a greater or less fermentation. No doubt this was detestable, but then no one ever thought of regaling himself with this liquid. It was never taken alone, but was reserved as a seasoning for a host of dishes in order to heighten their flavor." Apicius, that greatest of authorities among Roman cooks, "places it in almost every sauce, but never serves it by itself, nor does he use it unmixed." It was so strong and foul that it could not be eaten by itself, but to offset that they befouled all other dishes with it.

Garum itself has dropped out of our legacies from this ancient cookery, and from those impure times; but not so all the principles that lay at the foundation of its use. We find them still in the fermentation, the indigestibility, and the artificiality of many of our food preparations. By fermentation we have prepared a great many poisonous drinks; we have destroyed much nutrition in bread and bread preparations; spoiled many good fruits and vegetables by making them indigestible, as pickles and sweet pickles, and brandied fruits; but above all, we have inherited so artificial a style of cooking that our cooks study the rules, the recipes, and the cook-books, and never the nature of the materials, only so far as to ascertain their plasticity with regard to shape. This tendency to artificiality is one of the greatest misfortunes now in our cookery. It so dominates us that we have very little thought of originality. Women who can invent fashions, trim up or make their own bonnets out of old materials, and make over dresses to look good as new, scarcely ever get up a new dish for their tables. If they do chance to vary an old style, under the force of circumstances, and get a good result, they seldom follow it up and perfect it until they make a new and permanent dish. And this is largely because they do not understand the principles of cookery or the harmonies of combination. These harmonies are not recognized. They have scarcely seen the light since they were pared into the grotesque shapes that disgraced the Roman tables and drenched into uniformity of taste with garum and kindred devices.

A lady who has had long experience of "skilled" English cooks, remarked to me that their dishes were usually attractive in appearance, but disappointing to the taste. The French women are more apt in their study of materials, and more enterprising in their combinations; but we have only to look into books like that of Blot to see "two bay-leaves and a sprig of thyme," repeated with a frequency that inevitably brings to mind the garum of Apicius. If any thoughtful mind could fail to see the probability of perpetuating error in the unquestioning uniformity with which the daughte follows the mother in her cookery, we might trace the descent of still other preparations that have come down to us like the fattened geese livers, the yeast, and other products of fermentation; but we hope enough has been said to awake a questioning spirit which shall refuse to take any recipe or custom merely because it has the sanction of age. Any abomination sanctioned by age is doubly an abomination, and requires greater energy of effort to contest its demands. We do not wish our government or people to copy the excesses of the Roman people, and certainly in their later days their excesses had everything to do with their artificial and luxurious cookery. The bare possibility that in our traditional recipes we may be drinking from a fountain so defiled as the Roman cookery, should lead us to seek for fresher springs and for natural fountains. And if we can learn from all this waywardness some reasons for naturalness and its advantages, it will not be in vain that we have studied for a little while the artificiality of a dominant phase of ancient cookery.—*Julia Coleman in Phrenological Journal.*

WHY MILK SOURS DURING THUNDERSTORMS.

BY MALVERN W. ILES, PH. D.

There have been various surmises in regard to this subject; none, so far as we have been able to learn, have been substantiated by experiments.

In order to see if milk did really sour during heavy thunderstorms, I made several observations which proved to me that this was not an erroneous opinion which is so commonly held by the dairymen. My experiments to arrive at the cause of the phenomena thus observed may be stated as follows:

I took skimmed morning's milk, filled a eudiometer tube (300 c. c.), then introduced 100 c. c. pure oxygen gas.

Then by the use of an ordinary battery, and a small Ruhmkoff coil, caused sparks of electricity to pass through the oxygen for five minutes. The current was then broken, the tubes shaken up and allowed to stand for five minutes. The milk does not appear quite as opaque, and shows a noticeable acid reaction.

On continuing the current for five minutes longer, making in all 10 minutes, the milk curdles very perceptibly, and shows a decided acid reaction.

The contents of the tube on standing for twenty minutes had reached the consistency of ordinary sour milk or bonny-clabber.

From the above experiments it will be seen that the oxygen was converted into ozone, which we think may be stated as the cause for the rapid souring of milk during thunderstorms.

The increased acidity is due to the formation of lactic acid, and most probably some acetic acid, by means of the ozone. One or both these acids, then, causes the casein to be precipitated.—*Scientific American.*

A SIMPLE METHOD OF VENTILATING ROOMS.

Dr. H. N. Dodge informs us that he has found the following plan very satisfactory for the ventilation of rooms that are much used during cold weather: Nail or screw a neat strip of wood, from one to two inches high, upon the window sill, just inside of the sash and extending entirely across from one side of the window frame to the other. Upon the top of this strip fasten a piece of ordinary "weather strip" so that there will be formed an air-tight joint between the "weather strip" and the lower sash of the window, whether the latter is shut down tight or raised an inch or two, the lower cross-piece of the sash sliding on the rubber of the "weather strip" as the sash rises. With this simple fixture in place the lower sash may be raised enough to admit a stream of air between the lower and upper sashes, where they lap over each other at the middle of the window, without admitting the least air at the window sill. The air admitted between the sashes is thrown directly up toward the ceiling, and there mixes with the heated air at the upper part of the room. The room is thereby ventilated in a thorough and agreeable manner without drafts of cold air upon the persons in the room. The fixture should be applied to several windows in a room. The amount of ventilation may be regulated by the distance that the lower sash is raised. This arrangement is cheap, simple, and effective. —*Scientific American.*

Production of Crystalline Figures Upon Glass or Paper.—Window-panes, wall-paper, or other surfaces may be handsomely decorated by means of the following simple process: Prepare as concentrated a solution as possible of any easily crystallizable salt, as magnesium sulphate, zinc sulphate, etc., and dissolve in it a small quantity of dextrin. Filter the solution through white filtering paper, and apply it evenly and thinly, by means of a broad brush, to the glass or other surface, which is then kept in a horizontal position for about fifteen minutes. During this time most magnificent groupings of crystals make their appearance, resembling the ice-flowers of winter, which adhere firmly to the surface, but may be permanently fixed by means of a thin coating of shellac. If it is desired to remove part of the coating, as, for instance, to examine the crystals for their optical behavior towards polarized light, it is only necessary to pour a thin layer of collodion over them, and, after drying, to strip the latter carefully off. In this way the whole crystal group may be lifted off the glass, adhering to the collodion film.—*New Remedies.*

Washing Flannels.—A lady correspondent says: "I will give a little of my experience in washing flannels. I was taught to wash flannel in hot water, but it is a great mistake. In Italy my flannels were a wonder to me; they always came home from the wash so soft and white. I learned that the Italian women washed them in cold water. Many a time have I watched them kneeling in a box, which had one end taken out, to keep them out of the mud, by the bank of a stream, washing in the running water and drying on the bank or gravel, without boiling; and I never had washing done better, and flannels never half so well. I have tried it since, and find the secret of nice soft flannels to be the washing of them in cold or luke-warm water, and plenty of stretching before hanging out. Many receipts say, Don't rub soap on flannels; but you can rub soap on to the advantage of the flannels, if you will rinse it out afterward and use no hot water about them, not forgetting to stretch the threads in both directions before drying. Flannels so cared for will never become stiff, shrunken, or yellow.—*Boston Journal of Chemistry.*

To Remove Silver Stains from Woven Fabrics.—The following process is said to be especially successful in removing spots from materials which have been several times washed: First prepare a saturated solution of chloride of copper; dip the spotted piece in the solution, and allow it to remain some minutes, or according to the character of the stains. Then rub the stains with a crystal of hyposulphite of soda. When neutral chloride copper is used, the color of the stuff does not change. This process can be repeated.

To Wash Red Table Linen.—Use tepid water, with a little powdered borax, which serves to set the color; wash the linen separately and quickly, using very little soap; rinse in tepid water, containing a little boiled starch; hang to dry in the shade, and iron when almost dry.

SCIENTIFIC MISCELLANY.

CLEOPATRA'S NEEDLE.

Waterloo Place was the site always thought of from 1820, the date of Mehemet Ali's gift of the obelisk to George IV, soon after which the nation was led to look for its erection on that spot, "for ages to serve to revive the recollection of the exploits of our naval and military heroes." Sir Robert Peel at that time told Lord Westmeath he thought it was a monument which ought to be brought to London and erected as a memorial to Sir Ralph Abercromby and others, who had fought and died in Egypt. But the question slept for thirty years, until, on the 2d of June, 1851, Lord Westmeath cited these authoritative opinions in putting his question to the Earl of Carlisle in the House of Lords as to the means which had been taken for appropriating and removing the obelisk to this country. On this occasion Lord Westmeath tried in vain to overthrow by counter testimony the damaging report of the late Sir Gardiner Wilkinson—that the inscriptions were in so bad a state that the obelisk was not worth removing. Mr. Hume, also, on the following July 1, was fain to withdraw his motion in the Commons for the removal of the obelisk, which was thought not worth the cost, although he offered to bring it to this country for £7,000. Happily, Sir Gardiner Wilkinson turns out, in this instance at least, to have been far from infallible. Prof. Wilson, while frankly owning the weather-beaten look of the monolith after the 3500 years through which he holds it to have battled with time, describes cheerily enough the rugged rose granite's tight grip of the written record intrusted to its keeping: "In places it will be seen that the angles are rounded; here and there the once burnished surface is blurred and rough, and some of the engraving had suffered almost to obliteration; nevertheless, as a whole, it is remarkably perfect. It is said to be in better preservation than the standing Needle at Alexandria; it has happily escaped serious injury from its fall; and its entombment in the sands of the seashore and the rubbish of building material would seem to have been favorable to its preservation. The sides most injured are those to landward, and the agents of mischief the sharp pellets which ride in the sand storms so common in Egypt, that drive their sharp and piercing atoms against an opposing surface with the fury of musket shot."

It is worth notice, in passing, that the present is just the 1900th year since the Augustan ceremonial. Of course, when that happened Cleopatra had been dead seven or eight years. But against the suggestion that she had, therefore, no right to give her name to the Needles, it is plausibly urged that she might have designed their removal from Heliopolis, the Biblical On, where the inscriptions on them say they originally stood, as she may have designed the temple of Cæsar itself. Prof. Wilson dwells on the interesting associations of our monolith with On and with the Land of Goshen, in which the metropolis of Egyptian learning stood, and so with the history of the Hebrew patriarchs and people, with their great leader, Moses. Moreover, under the shadow of its now lone obelisk, the oldest in the world, tradition locates the Holy Family. "Originally there were three pairs of obelisks at On, but of these only one single obelisk remains, almost the sole surviving relic of that ancient city." Prof. Wilson thinks it was erected nearly 5000 years ago. The other four obelisks were all set up by Thothmes III. and his family. "Two of these four were called Pharaoh's Needles, and now serve to decorate the cities of Constantinople and Rome, while the remaining two were transferred to Alexandria to become celebrated as Cleopatra's Needles." It is plain "Our Egyptian Obelisk" need not be ashamed of its lineage. Nowhere in the land of obelisks, not even at sacred Thebes, did there ever stand a finer or more interesting group of these monoliths, all symbols of the Sun-god's rays, than the three pairs which guarded the pylons of his temple in his own city, On. Of the six, but one has disappeared. Its surviving sister, the noble shaft of Usertasen I, who heads the grandly historical Twelfth Dynasty, still keeps lonely watch on the spot. Of the other four, all bearing the name of the greatest conqueror of the new empire down to Alexander, not excepting Ramses-Sesostris, two are divided between old and new Rome, the third marks the site of the old part of Alexander's Egyptian capital, and we are now craning our necks in expectation of the arrival of its fellow in the greatest city of the modern world.—*London Times.*

Raising Roses from Seed.—To raise roses from seed, take the seed when fully ripe, separate them from the pulp, mix them with moist sand, put them in a little box or flower-pot, and then place them in the cellar, taking care that they are kept moist all winter. In the spring sow sand and all in a common hot-bed, and when the plants are about an inch high transplant them into light, rich soil, shading them till well rooted.

PROCEEDINGS OF THE ST. LOUIS ACADEMY OF SCIENCE.

A regular meeting of the St. Louis Academy of Science was held Nov. 5th, at the Polytechnic Building. The chair was taken by Prof. Riley. There were also present, Dr. Engelmann, Judge Holmes, W. T. Harris, Dr. Alleyne, Dr. Forbes, M. L. Gray, F. W. Raeder, Willis N. Graves, Judge Albert Todd, O. W. Collett, and F. E. Nipher, Secretary.

After routine business had been disposed of, Judge Holmes made some very interesting comments upon a paper treating of the origin of the human species in America. The theory advanced was the probability of the existence in the miocene period of a land connection between Scotland and Greenland, over which emigration took place from the Old to the New World. It was also probable that, in the post pliocene period, Southeastern Asia, New Holland and America were also connected by land, the bed of the ocean in both of the parts where the land connection once existed being now but 500 fathoms below the surface of the water. The speaker, whose comments were received with deep interest, closed with the remark that the theories advanced should not be rejected simply on the ground that they seemed improbable.

The Chair remarked that scientists had begun to learn that it was unsafe to reject new theories on scientific subjects, simply because of their improbability, and hence the Society should not disregard altogether a communication submitted to it by a person who had devoted his time to the invention of a flying machine. The Chair did not himself believe that any apparatus would ever be perfected by which a man would be enabled to so apply his own muscular power as to enable him to fly, though at the same time he had faith that by properly applying the principle of the screw a machine would, perhaps, within the next ten years be invented which would travel through the air.

Dr. Holmes announced that he had prepared a paper, with illustrations, upon the *agave shaevi*, a flower from the Pacific coast, which had excited much interest among St. Louis horticulturists. The paper was referred to the Publication Committee.

Dr. C. V. Riley then read a paper on the larvæ habits of the blister beetle, an insect of great commercial value, some of which were quite common in the United States and were in their developed state frequently very injurious to vegetation. It had been supposed that these larvæ, as a rule, lived in the earth and fed upon the roots of plants. Late investigations, however, had shown that the larvæ of the European blister beetle are parasites, living in the cells of the honey bee and feeding upon the eggs therein. They differ from other larvæ in having seven instead of four stages of existence. The paper contained an interesting description of the life of the larva of the European beetle from the first stage in which it formed its home in the hive by attaching itself to the bee by means of a sticky fluid which exudes from its spinneret, through its other stages and up to the time of its full development. In America the blister beetle was the parasite of the locust. The female blister beetle selected warm sunny spots of earth in which to lay her eggs, her instincts inducing her to choose a place for oviposition where the locusts also deposited their ova. Immediately upon receiving life the larva secures a locust egg, the contents of which it sucks up. In cases where two larvæ happen to strike upon the same egg a fight invariably ensues whose only termination was the death of one or both combatants. From the reader's investigations he was able to say that in all probability from St. Louis southwards there were two generations of larvæ every year. The paper, which will be published with illustrations, will be a very valuable addition to American entomological discovery.

On motion, the paper just read, and one or two others, whose titles he announced, were referred to the Publication Committee.

In answer to a question, Prof. Riley stated that, while there were no blister beetles in America exactly similar to those of Southern Europe, yet it had been shown that the American insect was as valuable, commercially, as its transatlantic congener.

Dr. Englemann stated that, as a result of his meteorological observations, he was able to announce that the first frost of the year would occur last night. There had been white frosts in various parts of the State, but during the night there would be a black frost, which would kill plants—a thing which had not yet happened this year. This was later, on an average, than usual. He prophesied that this morning the castor-oil plants, which were blooming during yesterday, would be killed by the frost to-day.—*Globe-Democrat.*

FOSSILIZATION OF FLESH.

Prof. Mudge responds to the criticism of "M. D." in the Kansas City *Times*, as follows:

NEWTON CENTER, MASS., Nov. 21, 1877.

Your paper, containing a criticism on my article in the WESTERN REVIEW in relation to the fossilization of flesh, has just reached me here. If the gentleman will take the trouble to study the question as much as I have done he will find that I am correct; and that no fossil flesh is known in science. The cases cited from Pompeii are well known. They are casts of the human form, not fossilization of the human flesh. The moist ashes covered the bodies, the fleshy portions decayed, leaving a cavity containing nothing but bones. The layer of ashes became so firm that artificial casts were made of the cavity, from which the photographs were made.

From personal acquaintance with the museum at Yale College, I can say that Mr. Boyer, cited by M. D., is mistaken, and that no fossil flesh is contained in that collection. The nearest approach is the membrane (skin) wing of a small Pterodactyl, the only specimen known, which cost Prof. Marsh $1,000 in Europe.

The petrifactions of the shells of oysters in Colorado I have seen by the cartloads, but the soft eatable portions are never fossilized. The case cited from Monrovia, (not "Munervia,") Kansas, I recollect, and similar cases are frequently reported in newspapers, but whenever a scientific person has had the opportunity to examine the bodies, the flesh has never been found fossilized.

M. D.'s quotations from Chamber's Encyclopedia are in harmony with my statements. "Organic remains" include wood, shells and bones. The "animal remains" of the oyster in the shell is carbonate of lime. In bones it is phosphate of lime, and "the original cell structure, however minute and delicate, remains, and is still seen under the microscope." "Erenberg found 42,000,000,000 (forty-two trillions) of fossil infusoria in one cubic inch of tripoli, each perfect in structure." In the latter case the animal basis was silica, the soft fleshy portions of the body were not fossilized. The Struthious birds of New Zealand I have frequently examined. There is no flesh on the bones, but then phosphate of lime remains nearly as when living.

This statement, that flesh is never petrified may strike M. D. "as being absurd, if not utterly ridiculous," but he will find it correct. Now if he will only produce flesh petrified or fossilized, he will not only render a great favor to science, but he can also enrich himself by selling it at a high price.

In the course of Professor Rood's researches respecting colors, of which some account was recently given in the report of the proceedings of the National Academy of Sciences, he obtained a numerical value for the luminosity of different tints. The results are as follows: White paper being estimated as having a luminosity of 100, vermillion has 23.8, blue-green 26.56, chrome yellow 80.3, cobalt-blue 35.38, green 41.19, purple 14.83. The vermillion was spread over the paper in a thick paste. The blue-green consisted of a mixture of emerald-green and cobalt-blue, applied in a thick paste. The chrome yellow was of the pale kind, and was applied in a series of washes, after the manner of water-color painting. The cobalt-blue was applied in the same way as the chrome-yellow. The green was a mixture of emerald-green and chrome-yellow, applied as a thick paste. The purple was an aniline color.

From statements made at a meeting of the California Academy of Science, the eucalyptus tree may be enumerated among the means for checking fire. Eucalyptus shingles are said to be fire-proof. A tree of this species was exposed to the San Francisco fire of 1876, and is still flourishing. The notion is urged that the spread of fires in cities could be checked by setting out such trees for shade and ornament. All varieties of the eucalyptus are said to possess this valuable property.

Experiments with Ammonia and Flowers.—A French journal states that Professor Gobba has lately made a series of experiments for the purpose of determining the changes which ammonia produces in the colors of different flowers. For this purpose he merely makes use of a dish in which is poured a small quantity of common aqua ammonia. Over this he places a funnel, in the tube of which are inserted the flowers to be experimented upon. In this way he has shown that blue, violet, and purple flowers change to a beautiful green; deep red carmine flowers to black, white to yellow, etc. These changes are most striking when the flowers have several different tints, in which the red lines are turned green, the white yellow, etc. An interesting example is that of the fuchsias, with white and red flowers, which in consequence of the ammonia vapor become yellow, blue, and green. If, when these changes have taken place, the flowers are immersed in pure water, they preserve their new colors for several hours, after which they gradually resume their original tints. Another observation due to Dr. Gobba is that the flowers of the asters, which are naturally inodorous, acquire a very agreeable perfume under the influence of ammonia. The flowers of the violet asters also become red when they are moistened with a diluted solution of nitric acid. Again, these same flowers, if exposed in an open box to the vapor of hydrochloric acid, become after some hours of a beautiful carmine red, which they preserve, after being dried in the dark, if kept in a dry, dark place. Our readers may like to try some of these experiments.—*Boston Journal of Chemistry.*

A Deep Well.—English geologists have watched with great interest the progress of a well which has been bored for the benefit of a London brewery, and which has just been successfully finished. At 150 feet the clays and gravels were passed, and the upper chalk began, from 490 to 812 feet the work lay through hard lower chalk and marl; at 840 feet, gault; at 1,004 feet the solid green-sand was reached below which water is always found. The work was done with a diamond drill. One crown of diamonds has cut 400 feet; but the strata have proved of very varied hardness, and the flints in the chalk have occasionally delayed the speed of the work. When there are no mishaps the progress is 14 or 15 feet a day. The value of the diamond crown of the boring tool is about $500.

The city of Providence, R. I., is excited concerning its waterworks. A Cornish steam engine in use, which is estimated to have cost $580,000, is said to be cracked and disabled. As a preliminary to giving the public an education in respect to waterworks and engineering, so that intelligent measures shall hereafter be adopted, the Providence *Evening Press* has issued an illustrated "extra," containing a descriptive history of the invention of the Cornish steam engine, beginning with the attempts of a century ago. The "extra" is illustrated. Probably the moral to be enforced is to buy somebody's pump.

The mode of development of deers' antlers formed the subject of a valuable essay, delivered by Professor Theodore Gill, before the National Academy of Sciences at its recent meeting. The following were the chief conclusions reached: Antlers are horn-like appendages of frontal processes, peculiar to the deer, developed periodically and concomitantly with the sexual organs, chiefly in the males, either as simple spikes or with a tendency to bifurcation, especially (but not exclusively) in the direction of greatest or axial growth. The modification of the antlers and their contour in the various forms of the family, are chiefly dependent on and determined by the diverse exhibitions of this tendency, and examples of several kinds are furnished by the general Cervus, Cariacus, (also Rusa, Pudua,) and Elaphurus. As is generally known, in all the deer the antlers of the first year, at least, are simple spikes. In Pudua, the antlers remain simple and never bifurcate. In Cervus, the direction of growth is continuously upward and backward, and dichotomization takes place from the hindmost prong of the preceding year, the antlers being differentiated, however, into posterior "beams" and anterior "brow-antlers." In Cariacus, the direction of greatest growth is deflected and the main axis continues sub-spirally forward into the homologues of the anterior upper prongs of the fourth year. Rusa exhibits a similar tendency. In Elaphurus, the direction of principal growth is upward from the base and forward, and the antlers are differentiated into two elements, (1) the anterior being homologous with the brow antlers of Cervus and functionally usurping the place of the main ones, and (2) the posterior being correspondingly reduced and thrown backward.—*N. Y. Tribune.*

The postponement of the Woodruff Scientific Expedition till next May seems to have been resolved upon rather suddenly. Within a few days previous to the announcement of the change of plan, the expectation of departure during the present month was encouraged.

Brazilian Meteoric Iron.—A meteorite from Brazil has been analysed, and found to contain 64 per cent. of iron, and 36 per cent. of nickel, corresponding thus nearly to the formula Fe_2Ni. It is remarkable for its richness in the latter metal.—*Boston Journal of Chemistry.*

Canajoharie, in this State, boasts the possession of a stone relic, recently found below the surface in making an excavation. Its size, strange to say, is not given in the newspaper accounts. The stone is believed to be very ancient, and is carved in a shape that is said to bear close resemblance to the Egyptian Sphynx. Perhaps, too, it may present a perpetual riddle.

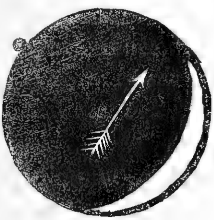
ASTRONOMY.

THE OCCULTATION OF VENUS.

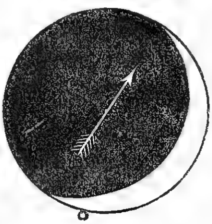
On the evening of December 8th an occultation of Venus by the moon occurred, and, as the night was beautiful and clear, the spectacle was witnessed by a large number of our citizens.

We reprint from the *Journal of Commerce*, of this city, the following description, and at the same time acknowledge our indebtedness for the use of the cuts illustrating the occultation:

The following diagrams illustrate the position of the planet, with reference to the moon, at the beginning and end of the occultation, as seen from Kansas City. The arrows represent the direction of the *astronomical* north and south; the angle which the arrows form with the column rules of the paper is equal to what is known to astronomers as the parallactic angle. It value is 34.3 degrees. The times given below are calculated as nearly as can be done by an "amateur" astronomer without the aid of the instruments necessary to a minute calculation.



No. 1.



No. 2.

[A vexatious blunder by the engraver, too late to be remedied, makes it necessary to explain that the white crescent represents the visible portion of the moon, and the black part the invisible portion.]

At about ten minutes past six, the moon being about 15 degrees above the horizon in the west, the position of Venus will be on the upper left of the moon's dark limb, which will then begin to creep over the planet. The apparent diameter of Venus is, then, 24.8 seconds of an arc; a distance which the moon will describe in very nearly one minute of time. But, as seen through the telescope, Venus is almost exactly half full, giving a miniature representation of the moon when the latter is a week old. The bright half of the planetary disc is that nearest the moon, and it will be covered in about thirty seconds after the beginning of the occultation, though the light of the planet may be partially visible to the naked eye for a very few seconds more. This will be the most interesting phase of the phenomenon. The dark limb of the moon *may be* faintly visible at the time: this will depend chiefly upon the quantity of cloud vapor in the atmosphere to the southwest of us. It will probably be invisible, and in that case, if the sky be clear here, the brilliant planet will present the strange appearance of being utterly extinguished, in the short space of half a minute, without obvious cause, Venus being 0.4 degrees distant from the nearest point of the lunar cresent. If the dark part of the moon should be faintly perceptible we shall then have a chance to see the old "Dragon" of ancient stellar lore literally eating its way into the Hesperian star, and swallowing her up into utter darkness.

The planet will remain behind the moon for one hour and two minutes, as seen from Kansas City. At about fifteen minutes past seven o'clock the planet will peep out from behind the southern horn of the moon, near the position shown in our second diagram, and occupy 1.3 minutes in emerging, the motion outward being very oblique. Her position at emersion will be 156 degrees from the astronomically north point of the moon's limb; and 15½ degrees east from the point of the limb which is nearest to the horizon. At this time the moon's altitude will be only 8.7 degrees from the horizon.

The time and phase of the event vary materially with the point on the earth's surface on which the observer is situated. The reason for this is found in her relatively small distance from the earth, which causes an angular change in her position equal to her whole diameter, corresponding to a difference of about thirty-three degrees in latitude on the earth's surface. Two observers may be separated by thirty-three degrees of latitude, and one of them see a star apparently on the southern limb of the moon, at the same instant that the other observer sees the same star on her northern limb. It is this fact that makes the calculation of an occultation, or solar eclipse, a lengthy one, involving the solution of several spherical triangles, and making a knowledge of the calculus highly desirable, though not an absolute necessity. The apparent position of the moon, with reference to the star or planet, at any instant varies with the position of the observer on the earth's surface.

The occultation of Venus by the moon, when both are favorably situated for observation, is a very rare phenomenon. The last exhibition of the kind witnessed here occurred seventeen years ago, in April, 1860. The planet was then, as now, near her greatest eastern elongation from the sun, and the moon four days old; but both were much higher than they will be to-night, as they were near the northern solstice.

The distance of Venus from the earth at the time will be about 257 times that of the moon, the respective distances being 63,000,000 and 240,000. This fact enables us to account for the apparently small size of Venus, though her lineal diameter is to that of the moon as 362 to 100.

THE AGE OF THE SUN.

There has been a long dispute between the physicists and mathematicians on the one hand and the geologists and biologists on the other, as to the age of the earth, or rather, since that is equally involved, the age of the sun.

Dr. Croll, the distinguished Scotch geologist, has recently offered a theory which is not altogether new, but admits of some novel arguments, and which may serve all parties to the dispute. Beginning with a review of the different theories as to the sun's heat, he rejects the combustion theory as totally inadequate, since if the sun were all a burning coal, it would not last over 5,000 years; the chemical theory does not prolong the duration sufficiently; the meteoric theory will not serve; the only remaining theory is the gravitation or condensation theory. This supposes that the materials of the solar system were originally a nebula, extending through a space many times greater than the orbit of Neptune. The falling together, the condensation of this amount of matter, it can be mathematically shown, would supply enough heat to keep the sun at its present temperature for 20,000,000 years. Unfortunately, that period is not sufficient for the geologist. He demands at least 100,000,000 years for the changes of the earth's surface and would prefer twice that length of time. The arguments of the geologist are almost unanswerable; those of the biologist who believe in evolution tend to the same point so far as they go. Prof. Croll says that there is a way out of this difficulty, by supposing that the nebula was not cold but hot. If you suppose it hot enough to start with, you will have heat enough to carry you through. Obviously it is just as easy to suppose a hot nebula as a cold one. But Prof. Croll proposes to provide for this original heat. If the solar system had originally consisted of two masses, each of half the density of the whole, at some immeasurable distance apart, and they fell foul of each other owing to their mutual gravitation, they would strike with a speed of 274 miles per second. If their motion was stopped by the concussion, an amount of heat would be developed sufficient to convert the whole into a nebula that would take 50,000,000 years to cool. This is decidedly an improvement on the cold nebula. But this supposes that the component halves before they started on their way to a collision; had no motion. Let us suppose that they were moving beforehand at the rate of 202 miles per second, and that this speed was added to what they got by gravitating toward each other; then we get, when they struck, a nebula extending beyond Neptune, and with heat enough for a sun of 100,000,000 years' of duration. If you insist on 200,000,000, you must give the original masses a speed of 676 miles per second, beforehand. It will be objected that no such motion has been observed in space. Even the planets do not make such fast time; the earth, for instance, going only a thousand miles in a minute. The fixed stars, whose motion has been ascertained, travel very much slower. But Prof. Croll says the fixed stars are those that have gone through the collision process, and have lost their motion. The new hypothesis goes behind the ordinary nebular theory in point of time, giving an explanation for the formation of the nebulæ. But it presupposes that there may be vast, cold, invisible masses of matter rushing through space with such velocity that their mere touch would convert our globe into red hot gases and distribute it through infinite space. The conception is not incompatible with the sudden flaming out of a new star and its conversion into a nebula, as seems to have been the case with the Schmidt star in Cygnus; but the facts in that remarkable case were probably not known to Prof. Croll at the time his essay was written.—*N. Y. Tribune.*

WHAT HAS BECOME OF THE NEW STAR?

A remarkable discovery has been made by the astronomers of Lord Lindsay's observatory at Dunecht—a discovery the true meaning of which is not as yet fully perceived. It may be remembered that some nine months ago a new star, as it was called, made its appearance in the constellation Cygnus. This object shone out where before no star had been known to astronomers—not merely, be it noticed, where there was no visible star, but where none was recorded even in lists like Argelander's "Durchmusterung," containing hundreds of thousands of telescopic stars. It was not, however, altogether impossible that some small star within moderate telescopic range had existed in the spot where the new star shone out, and that in some way this small star had escaped observation. This seemed the more likely, because the new star had appeared in a part of the heavens very rich indeed in telescopic stars; at any rate, astronomers had reason to believe that they would be readily able to determine the question with a high degree of probability by watching the star as it gradually faded out of view. For a "new star" which had shone out in the constellation of the Northern Crown in May, 1866, and had been identified with a tenth-magnitude star in Argelander's list, had gradually faded out of view, and, growing yet fainter, had sunk through one telescopic magnitude after another until it shone again as a tenth-magnitude star only. Since that star had resumed its former lustre, or rather its former faintness, it seemed not unreasonable to conclude that so also would the star of Cygnus. We shall presently see how far this expectation was from being fulfilled.—*Prof. Proctor, in Popular Science Monthly for December.*

BOOK REVIEWS.

CONTEMPORARY ART IN EUROPE, by S. G. W. Benjamin; with illustrations. New York: Harper & Brothers; 1877. pp. 165, octavo. For sale by Matt. Foster & Co. Price, $3.50.

This book, which presents in its mechanical execution a choice specimen of the highest style of the "art preservative," is made up from a number of articles entitled "Contemporary Art in Europe,' which appeared in *Harper's Monthly* during the past year, where they attracted marked attention from their graceful style, and at the same time, from the intimate acquaintance with the subject manifested by the writer; also from the numerous most excellent illustrative engravings.

It is certainly a very opportune time for the sale of such a work in the United States, since we are as a people rapidly becoming imbued with a love of art in its higher and truer forms. As the author says, "we are evidently entering upon a period of art development that shall crystallize the still unformed and unorganized art talent of the community into art schools such as have distinguished the Old World." In order to do this successfully and systematically it is necessary for us to study art in other countries and among other peoples for the purpose of obtaining a clear idea of the philosophy of its growth and prógress. The object of the author is to furnish us with a correct and comprehensive account of European art in its present condition.

Dividing the subject into the three heads of Contemporary Art in England, France and Germany, he first takes up that of England, and enters enthusiastically upon the subject, describing with minuteness the various art schools, such as the Royal Academy, the South Kensington Museum, the Grosvenor Gallery, &c., dwelling with artistic warmth upon the enormous amount of capital, labor and public interest expended upon art by the English people and government. After devoting more than fifty pages to a description of English artists of all classes, and works of art in every department of art including architecture, ceramic art and household art and illustrating them with wonderfully fine portraits of painters and representations of their characteristic productions, he seems to yield the palm to such artists as Millais and Leighton, and to conclude that some of the best work done in England is of the Decoration class.

Speaking of French art, he takes the position that no people ever had the art instinct more generally diffused, and that while the character of modern French art is sadly depraved, still it is due to the demoralization of the race, and that the responsibility rests with the public which demands such art; that while it is desirable that good art should be pure art, yet it may be technically of a high order while its moral tendencies may be debasing. That the original artistic genius of the nation continues in full force without any decline in vitality cannot be doubted. This is due, first to the natural talent of the people, and second to the fact that the French government has always fostered the growth of art by wise and far-seeing legislation and liberal appropriations. To such causes is attributable the immense galleries of Paris and the wonderful concentration of artists and art production which has caused the business connected with them to engross the attention of a large number and to employ perhaps a larger capital than any other legitimate business in the city, except that of hotels and restaurants.

Prominent among the government institutions for the encouragement of art are the Academie des Beaux Arts, the Ecole des Beaux Arts, the annual Exhibition of the Salon, the Hotel Drouǒt, besides which there are numerous public and private galleries, art clubs and art schools.

After giving the merits of each prominent artist of France an impartial discussion, he evidently inclines to award the premium in their respective classes to Corot for landscapes, Bonheur for animal painting, and Millet for *spirituel* portraits of humanity, while Brèton as an acknowledged leader of the sympathetic school excels all living French artists. French architecture and ceramic art receive at his hands a well merited commendation.

Of German arts and artists probably neither equals those of the 16th century, when Holbein, Aldegrever and Dürer were in the zenith of their success and fame. Germany has the advantage of a long continued prestige in this line, having for centuries maintained a reputation unequaled by any nation except Italy, and it would be most remarkable should France and England which have but recently, so to speak, acquired a reputation for art, come to the front as competitors with her for public favor. They, however, under the inspiration of government patronage and with the advantage of having their talent concentrated at London and Paris instead of being scattered over the whole kingdom as in Germany, have made rapid strides and in their respective schools are rivalling her. Still the grand art centers of Germany at Munich, Düsseldorf and Berlin are sending forth works by such artists as Lenbach, Gabriel Max, Defregger and Knaus, which can scarcely be excelled by any contemporary artists of Europe. The result of his study of German art is that it rivals French art in technical qualities and surpasses it in imagination and moral grandeur.

He concludes his consideration of European contemporary art with the suggestion that "while there is much to admire in its present condition, when the relation it bears to the future of American art is examined, the characteristic which more than all others merits the thoughtful and impartial consideration of our artists is the sturdiness with which each European school of art preserves its own national identity. The best modern art, the truest art of all ages and climes has been that which has been most faithful to the instincts of the period and race which gave it birth. If, therefore, we desire to see a worthy natural school of art spring up in our land, let us first of all be true to ourselves. By all means let the study of foreign contemporary and ancient art be pursued, but the notion that our native methods and native ideas and culture can never equal those of the Old World should be frowned upon as not only unpatriotic but unreasonable until proved by larger experience."

As before remarked, the book itself is a fine specimen of art, and the author has handled the subject in a most interesting, skillful and comprehensive manner.

THE TELEPHONE, By Prof. A. E. Dolbear, Tufts College, author of "The Art of Projecting," etc. Boston: Lee & Shepard; New York: Chas. T. Dillingham. pp. 128. Price, $1.00. For sale by H. H. Shepard, Kansas City.

This is a very appropriate work for our community just at this time, when we are about to have a lecture on the subject by Prof. Kedzie, of the State Agricultural College of Kansas, and for all persons who are interested in one of the most recent and useful discoveries in electricity.

Professor Dolbear discusses all the phenomena of sound, magnetism and electricity which are involved in the action of the Telephone, and gives directions for the construction of a speaking instrument invented by himself, in which magneto-electric currents are utilized for the transmission of speech and other sounds.

He also discusses the Telephones of Reiss, Gray and Bell, and concludes with the remark that there is nothing in the principles involved in their construction that was not known in 1840, and that "mechanism is all that is needed to realize completely the prophetic picture of the 'Graphic' of the orator who shall at the same instant address an audience in every city in the world."

It is a book of facts, lucidly written and very well illustrated with excellent wood cuts, well worth the perusal of all who desire to find the whole subject in a small compass.

MONEY AND LEGAL TENDER IN THE UNITED STATES, By H. R. Linderman, Director of the Mint. New York: G. P. Putnam's Sons; 1877. pp. 174, 12 mo. For sale by Matt Foster & Co. $1.25.

The object of this work is to set forth, in brief and convenient form, the laws relative to coinage, legal tender and the money standard of the country. Just at this time when the prominent national subject under consideration by Congress and by the people at large is that of bringing currency up to a specie basis, such a work will be found especially valuable, for whether all agree with Dr. Linderman's theories or not, all will accept his statements as unquestionable, and nine-tenths of those who read the work will be very glad to have these facts brought together for them in so convenient and compact a shape. The first chapter is devoted to a brief and uncommonly clear and definite explanation of the various terms used in treating of bullion, mint coinage and money, after which follow chapters upon the Provisions of the Constitution relative to the coinage of money and the regulation of its value; Legislation regulating the value of foreign coin; Metallic money in colonial times; Establishment of the mint, money standard, national coinage, money of account and legal tender; Coinage act of 1873, change from the dollar standard of gold and silver to the gold standard; What constitutes legal tender?; Paper currency since 1863; National currency secured by pledge of U. S. stocks; Mint weights and weighing of bullion and coin; Proposition for the remonetization of silver considered; Review of money situation in Europe; Appendix, with general summary and tabular statement of total coinage of the United States, etc. It is a work of decided interest and value to all classes, and doubtless will meet with great success.

THE AMOURS OF PHILLIPPE: A HISTORY OF PHILLIPPE'S LOVE AFFAIRS, By Octave Feuillet, translated from the French, complete and unabridged, by Mrs Mary Neal Sherwood, is published this day by T. B. Peterson & Brothers, Philadelphia. 50 cents.

It can be said of Octave Feuillet, as of very few contemporary French novelists, that he writes for the world and not simply for Paris. He writes of French life, but of life which Americans can understand, and not in that ghastly melodrama which is so foreign to all our natural sympathies, but which is brought before us again and again in the work of all the Parisian novelists of the day. This, his last romance, has just been completed in *Le Revue des Deux Mondes*, in Paris, passed through three editions in three days, and has been charmingly translated for Peterson's American edition, and is as strong and as earnest as any of the stories that have made Octave Feuillet's world-wide fame, being a series of keenly-drawn pictures of French social life by a dramatist and novelist who finishes as well as sketches his pictures, and who lives—not only exists—in the world that he paints.

OUR CHILDREN'S SONGS; illustrated. Harper & Bros., New York; 1878. pp. 208, octavo. For sale by Matt Foster & Co. $1.50.

This is truly a Christmas book for children of all ages and sizes, being a collection of all the juvenile poetry we have ever seen, and more too, from Jack and Gill in Songs for the nursery, through Songs for childhood, Songs for girlhood, Songs for boyhood to sacred songs for the nursery and hymns for childhood, closing with Bishop Heber's "Brightest and Best of the Sons of the Morning," and Joseph Addison's "Spacious Firmament on High;" the whole handsomely illustrated with nearly 100 engravings. It is just such a book as all children will be delighted with.

THE SIGNAL BOYS, OR CAPTAIN SAM'S COMPANY, By Geo. Cary Eggleston. New York: G. P. Putnam's Sons; 1878. 12 mo.; pp. 218. For sale by Matt Foster & Co. $1.50.

Another genuinely good story for boys; one which will not only interest them, but arouse their inventive faculties and stimulate them to deeds of manliness. Just such a book as every parent can unhesitatingly place in the hands of his son, with the certainty of his being benefited by it.

DOUBLEDAY'S CHILDREN, By Dalton Cook. G. P. Putnam's Sons, New York; 1877. 430 pp.; 12 mo. For sale by Matt Foster & Co. $1.50.

A story for children of a larger growth. The scenes are laid in England, France and Australia, and the author dextrously interweaves prominent historical events with the lives of his characters, making an entertaining and fascinating whole.

Signal Office Report from November 15 to December 15, 1877, by W. A. M. Vaughan, Observer, at Kansas City, Mo.

Date.	Missouri River above low water mark.	Direction of Wind.	State of Weather.	Remarks.
Nov. 15	5 feet 3 in.	S. W.	Clear.	
" 16	5 " 2 "	"	"	
" 17	5 " 8 "	"	"	
" 18	5 " 7 "	"	Fair.	
" 19	5 " 8 "	N. E.	Cloudy.	Light rain.
" 20	5 " 10 "	"	"	" .35 in.
" 21	5 " 8 "	"	Fair.	
" 22	5 " 9 "	"	Cloudy.	
" 23	5 " 8 "	S.	Clear.	
" 24	5 " 8 "	N. W.	Cloudy.	Light rain.
" 25	5 " 7 "	N. E.	"	
" 26	5 " 7 "	N. W.	"	
" 27	5 " 6 "	"	"	
" 28	5 " 10 "	"	Clear.	Ice running in river.
" 29	5 " 10 "	"	"	
" 30	5 " 6 "	N.	"	Ice running in river.
Dec. 1	5 " 5 "	S. W.	"	
" 2	5 " 5 "	"	Cloudy.	
" 3	5 " 4 "	N. W.	Fair.	
" 4	5 " 2 "	S. W.	Cloudy.	Light rain, .57 in.
" 5	5 " 0 "	N. W.	Fair.	
" 6	4 " 7 "	"	Clear.	
" 7	4 " 4 "	"	"	
" 8	4 " 0 "	N. E.	"	
" 9	4 " 0 "	S. W.	Fair.	
" 10	3 " 11 "	"	"	
" 11	3 " 11 "	"	Clear.	
" 12	4 " 0 "	"	"	
" 13	4 " 2 "	"	"	
" 14	4 " 1 "	"	Cloudy.	
" 15	4 " 0 "	"	Fair.	

Meteorological Record, by J. P. Kenmuir, Kansas City, Mo.

	BAROMETER.			FAHR. THERMOMETER.		
December	6 A. M.	1 P. M.	6 P. M.	6 A. M.	1 P. M.	6 P. M.
1	30.05	30.08	30.12	12°	30°	28°
2	30.05	29.93	29.90	26°	46°	40°
3	29.88	29.78	29.60	38°	36°	36°
4	29.41	29.50	29.66	38°	39°	36°
5	29.78	29.80	29.92	30°	32°	32°
6	30.10	30.16	30.06	24°	32°	34°
7	30.06	30.12	30.12	29°	43°	36°
8	30.25	30.25	30.22	28°	41°	35°
9	30.05	29.94	29.94	36°	52°	48°
10	30.00	30.00	30.00	36°	52°	50°
11	30.00	29.98	29.97	44°	58°	56°
12	29.97	29.95	29.98	47°	63°	56°
13	30.18	30.24	30.24	36°	52°	44°
14	30.18	30.24	29.97	34°	53°	48°
15	29.88	29.88	29.90	55°	61°	57°

EDITORIAL NOTES.

KANSAS CITY ACADEMY OF SCIENCE.

The Academy met at its rooms on the evening of the last Tuesday in November. The attendance was unusually large, the room being filled completely. Judge West occupied the chair, and Prof. Sheffield acted as Secretary.

A letter from Prof. W. K. Kedzie, of the Kansas Agricultural College, proposing to deliver a lecture during the Holidays, on the Telephone, with experiments, was read, and on motion a committee was appointed to arrange the time and place

On motion Mr. Francis Devens, of this city, was elected a member of the Academy, and appointed Taxidermist.

After some other business, a paper on "Some of the Objections to the Evolution Theory," was read by T. S. Case, which elicited an animated discussion. This was followed by a paper on "Short-Sightedness in School Children," by Prof. J. M. Greenwood, Principal of the Kansas City Public Schools. Both of these papers will be found in this number of the REVIEW.

At the request of the Academy, Col. R. T. Van Horn consented to furnish a paper for the next meeting, upon "The Atmosphere." It was also announced that Miss Murdfeldt, of St. Louis, would read an essay upon "Entomology," and that Prof. Broadhead, of Pleasant Hill, Mo, would read one upon the "Missouri Iron Ores of the Carboniferous Age." This will be a most interesting meeting and should draw a large audience.

THE lecture of Prof. Kedzie upon the Telephone will be illustrated by the use of twelve instruments, together with large charts explaining and illustrating the action of the instruments, and more than a mile of wire. The Professor writes to a friend in the city that he has been experimenting considerably and has made some very interesting discoveries. His lecture will take place December ..... of which due notice will be made in the daily papers.

THE subjoined letter, from an old citizen, will be of interest to those of our readers who pay attention to archæology:

KANSAS CITY, Nov. 29, 1877.

COL. CASE:—Hearing of the interest you take in the mounds of Missouri, and having traveled over all the State and examined a large number of them, I take this opportunity to give you a little information respecting the location of a few. The only one I ever examined closely was in Newton county, on Five Mile Creek, some eight miles southeast of Baxter. I opened a small mound there and found Indian bones, but they fell to a gray powder as soon as they were exposed to the air. I found a flint ax, fifty arrow heads, stone pipe, and ten copper rings, suppose they were on the Indian's arm. The largest mound I know of is in Cooper county, on the Lamine river, near Buffalo Prairie. It is half a mile south of the salt springs, on what is called the Bailey farm. To find it, take the M., K. & T. R. R. at Sedalia and go to Harris' Station, 21 miles from Sedalia. Inquire there for Conrad Cash and he will guide you to them. This mound is about twenty feet in diameter and about six feet high. There are several large trees near it, one on the top. It has large stones around it set up on edge. I had a man dig down three feet on top and he came to a large flat stone which seems to cover the whole mound. It sounded hollow and I think there is a kind of vault under it. The country surrounding this place was at one time a great hunting country, as the game came here from far and wide on account of the number of salt springs. The mound is on a high hill overlooking Saline county. C. C. C.

THE value of the storm warnings of the Signal Service becomes daily more apparent. The heavy gale in the midst of which the unfortunate Huron went ashore on the North Carolina coast was extremely severe in many parts of Virginia, Maryland and Georgia, as well as in other sections of the country. The floods caused by the sudden rising of the Potomac, the James, the Shenandoah and the Dan rivers, and many smaller streams in their vicinity, caused great destruction of property. In Richmond, Virginia, the lower part of the city was inundated, the flood spreading over whole blocks, submerging the gas works, leaving the city in darkness, and causing immense damage. Persons who remained in dwellings in the flooded locality were driven from floor to floor, and in many instances were finally removed in boats to places of safety. But the Signal Service had previously issued its warning note and foretold a sudden rise in the Virginia rivers, so that at Richmond and at other places much movable property had been placed beyond the reach of high water before the floods came. The same warnings were specially serviceable to shipping in harbor, and in the case of the Huron the result may be attributed directly to an over-confidence of Commander Ryan in his own ability and in the sea-worthiness of his vessel.

A NEW composite metal, called *Goloid*, has been lately patented and seems to present several valuable properties, which were recently explained by the inventor to the House Committee on Coinage, Weights and Measures. The composition represents 40 per cent as compared with gold and 60 per cent as compared with silver. When combined with alloy, the mixture representing the value of the silver dollar would be but half the bulk. He said it had one peculiarity. Its density is greater than the average density of its components. It is at a premium of three per cent in England today, for the reason that its chemical affinity for gold makes it a valuable agent in mining, and separates particles of gold which would otherwise be lost. One advantage which it possesses is its hardness, in which it exceeds gold.

A VERY LARGE AND BEAUTIFUL METEOR passed nearly over this city on Sunday, the 2d inst., at about 6 P. M. It was not so large, apparently, as that of last spring, but passed nearly in the same direction and at about the same rate of speed.

A smaller one was seen to fall from the northern sky, at about the same hour of the evening, on Nov. 29th. It was apparently very close to this city and seemed to fall in Clay county, just north of Harlem.

SIR JOSEPH HOOKER, who in company with Prof. Asa Gray and Prof. O. C. Marsh, passed through Kansas City last summer on his way to join Dr. Hayden's geographical survey, has returned to England and communicated the result of his observations to *Nature*, (Oct. 25.) Among other interesting things said with reference to the flora of the Rocky Mountains, he says: "Lastly, curious information was obtained respecting the ages of not only the big trees of California but of equally aged pines and junipers, which are proofs of that duration of existing conditions of climate for which evidence has hitherto been sought amongst fossil rather than living organisms."

PROF. HITCHCOCK is now engaged in securing some of the celebrated fossil bird tracks along the shore of Wethersfield Cove, near Hartford, Conn. To obviate the brittleness of the rock formation, he digs down deeply under any specimen he desires to obtain, and places in position a sort of platform of two-inch plank bolted together, fills underneath and around the rock with cement, which soon hardens and holds all together. In this way he is enabled to remove the entire mass in one body.

CAPT. TYSON has reported to Capt. Howgate the safe arrival of the arctic vessel Florence at Niantitick Harbor, Cumberland Gulf, on Sept. 29. Capt. Tyson proposed removing to and establishing his headquarters at the head of the Gulf in a few days and entering upon the work of collecting materials for the principal expedition next summer. Messrs. Sherman and Kumlein are doing well in their respective departments, though the latter hoped for better success in collecting specimens of natural history after the change of quarters.

THE Denver & Rio Grande R. R. (narrow Gauge) has been completed to Garland City, 27 miles from La Veta. The work will be pushed forward as rapidly as possible until the road reaches the San Juan mining district. Some of the finest engineering ever done in this country has been done on this road by Col. McMurtry, and it is claimed that it attains the highest elev tion of any railroad in the United States—nearly 9,339 feet above the level of the sea—in crossing the Sangre de Christo pass.

WE are pleased to announce that we can furnish the REVIEW for the succeeding year, with Popular Science Monthly, Popular Science Monthly Supplement, Van Nostrand's Engineering Magazine, Scientific American, New York Medical Journal, American Naturalist, American Journal of Science and Arts, North American Review, Atlantic Monthly, Harper's Monthly, Appleton's Journal, at rates much below the regular price of it and any one of them alone. Terms made known on application.

THE POSTAL GUIDE is a quarterly publication of over 200 pages, which contains information relative to the postal service, rates of foreign and domestic postage, rulings of the Department, list of post offices, money order offices, &c., &c, which every business man needs. We can furnish it at $1.50 per annum, or 50c. per single copy.

PROF. AUGHEY, of the Lincoln University of Nebraska, has written a very full and interesting account of the so-called Nebraska volcanoes, in which he explains that they are simply portions of the river bluffs which have been undermined and fallen into the water, where the sulphurets and other minerals have become slaked, thereby creating the heat which produces the steam, smoke and flames, causing the resemblance to real volcanoes.

PROF. TIFFIN SINKS, M. D., is delivering a series of lectures upon Evolution before the Leavenworth Academy of Science. The first of the course was given at the regular meeting in November, and, according to the *Times* of that city, was very able, creating a high degree of interest among his auditors. The second lecture will be delivered this evening, Dec. 18.

PROF. ROBERT GALLAWAY suggests the use of phosphate of potash is a much better remedy for scurvy than lime juice, and at the same time increases the nutritiveness of salted meat.

PERIODICALS RECEIVED.

New York Medical Journal, D. Appleton & Co., N. Y. $4.00
American Naturalist, H. O. Houghton & Co., Boston, ... 4.00
American Journal of Science and Arts, New Haven, ... 6.00
Popular Science Monthly, D. Appleton & Co., N Y., ... 5.00
Van Nostrand's Engineering Magazine, D. Van Nostrand, N. Y., ... 5 00
Gardener's Monthly, C. H. Marot, Phila., $2.10
North American Review, J. R. Osgood & Co., Boston, ... 5.00
Engineering and Mining Journal, N. Y., .. 4.00
Science Observer, Boston, ... 50
Boston Journal of Chemistry, Boston, ... 1.00
Sanitarain, N. Y., ... 3.00
Druggist's Circular, N. Y., ... 1.50
New Remedies, W. W. Wood & Co., N. Y. 1.50
London Journal of the Telegraph, London, 4s.
London Journal of Applied Science, " 4s.
Library Table, H. L. Hinton & Co , N. Y., 2 00
Monthly Weather Review, Washington, D C.
Popular Science Monthly, Supplement, N. Y., ... 3.00
Engineering and Mining Journal, N. Y , weekly, ... 4.00
Mines, Metals and Arts, C. E. Ware & Co , St. Louis, ... 2.00
Scientific American, N. Y , ... 3.20
Phrenological Journal, S. R. Wells & Co., N. Y , ... 2.00
Kansas Farmer, J. K. Hudson, ... 2.00
Western Agriculturist, Quincy, Ills., ... 2.00
Kansas Collegiate, Topeka, Kans., ... .50
The Jewell, Liberty, Mo , ... 1.00
Report of Kansas State Board of Agriculture.
The Institute, Nov., 1877, Glasgow, Mo.
The College Chaplet, St Joseph, Mo., ... 1.00
Medical Record, weekly, W. W. Wood & N. Y., ... 5.00
Ohio Educational Monthly, Salem, O., ... 1.50
Ohio Medical and Surgical Journal, Columbus, Ohio 2.00

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CORRESPONDENCE.

THE SAN JUAN MINES.—REVIEW OF THE PAST SEASON.

BY WM. WESTON.

Old Hyems has now closed his icy fist on the above region for 1877, and more especially on the dwellers and miners of the Pacific side of the Snowy Range. Snow has fallen unusually early and in large quantities, and here in the Sneffels District is about three feet on the level at this writing (Nov. 25th.) But though I pen this in a log cabin 10,800 feet above the sea level, have felt no inconvenience either from snow or temperature. If we want to take a trip round the basin to visit one of the three other cabins, whose occupants alone have had the hardihood to brave an eight months' winter in the clouds, we toddle around on Norwegian snow shoes, and it matters little though the snow be three or thirty feet deep. The thermometer has, for the last six weeks ranged between 10° and 20° Fahrenheit, at daybreak, and 30° to 36° at noon, but the air is so light and bracing that cold has not the depressing, chilling effect of lower altitudes. A friend of mine writing from London, England, says: "Your eight months' winter is a terrible weight." We don't find it so. My partner and I have built ourselves a snug log cabin, and well stocked it with "grub," powder and fuse, enough for an eight months' siege, and with plenty of warm clothes, books, drawing, writing, an assay furnace and outfit to test the ores, and our tunnel to work on during the day, we find the time passes rapidly and enjoyably Winter is *par excellence* the time to work a mine. The warm sun, green hillsides and valleys, and the perfume of a thousand flowers do not tempt you from your work, and you feel quite content to peg away with pick and shovel, sledge and drill, with the bright prospect of being, mayhaps, a millionaire in the spring.

The three principal silver mining districts of the San Juan are the Lake, Animas and Sneffels, and in all of these rapid strides toward improvement have taken place during the past season. In the first the strides seem to have been too rapid, and a rush to Lake City took place early in the spring, which neither the advance of the season or the richness of the mines in the least warranted. Hundreds went there and returned disgusted. They were of two classes—the capitalist, who on arriving there, found snow still deep on the ground and none of the mines to be seen; and the poor deluded wretches, who, misled by the lies published in "one-horse" mining sheets and copied into eastern newspapers by ignorant and careless editors, came in on foot expecting to find silver and gold lying about loose, or to get plenty of work at high wages. The former returned by the first coach—the latter, God knows what became of them—I saw dozens returning hungry and footsore. Lake City had a wagon road to it, and that is what made the place; Silverton, the capital of the Animas district, has none, and the one to Ouray, the only mining camp in this district, has been through Lake City. The consequence was, a tremendous rush to the latter place and it was over-run; a reaction has of course taken place, and it is now as flat as ditchwater.

There are two smelt mills there—Bernard's and Crook's—the former is buying ore, but has not yet made a vein; the latter has shut down and the owner gone out for the winter. There are also lixiviation works there which have been running all summer on ore from this district, packed to Lake City at a cost of $45 per ton. It was principally from the "Wheel of Fortune," whose ore (1st, 2d and 3rd class), has averaged this season 225 ounces of silver to the ton. Twenty tons of ore from this now celebrated mine, ran 800 ounces per ton. So some idea may be formed of the richness of the mines. These lixiviation works have also shut down and the owners gone out to hibernate elsewhere. In the mines around Silverton, great activity has been manifested this season. Greene & Co.'s smelter has been running night and day all summer, and they have sent out between 300 and 400 tons of bullion, averaging $250 per ton. The Cement Creek Chlorination works at Camp Gladstone, seven miles from Silverton, have been erected this season for a London company by Mr. J. H. Ernest Waters, M. E., F.R. S., a graduate of the Royal School of Mines, and an engineer of some distinction in English mining circles. Their machinery is all in, and by this time they have made their trial run. Their capacity is 15 tons per diem; Greene & Co.'s 10. Messrs. Melville & Summerfield's Lightning Amalgation works in Silverton, through some mistake in the management, failed to give satisfactory results on their trial run, which they were unable to make until near the close of the season, owing to their machinery having been delayed on the range; the proprietors, however, pluckily went to work at once to remedy the evil, and will be running next season early. All this machinery has been brought over the summit of the main range at an altitude of 12,400 feet above tide-water, and with no road; and the want of one is all that holds the district back. I, myself, brought out this spring a young Englishman of wealth, to build this toll-road into Silverton, but as soon as he saw the mines and their richness, he did what others have done before him—threw overboard the legitimate enterprise and went into mining speculations—and so it goes on from year to year. The consequence is, that the people of Silverton and the Animas district, have to depend on pack animals to bring in nearly all the necesssaries of life, and at a cost of about four cents per pound from the end of the Denver and Rio Grande railway. Is not this a millstone round the neck of any people? A Mr. Jones, of New York, who has purchased some mines in Cunningham gulch, and is running compressed air drills in a tunnel of a prospective length of 2,000 feet, has taken the road in hand, and already built it from the Silverton side to near the summit of the range, and intends to complete it early next season. Then the district will "boom," and the hundreds of good mines whose produce is galena, running 40 to 50 ounces silver to the ton (and which is now rated "low grade," and will not pay to work), will be in full blast; and the lead, which is now worthless, will pay the carriage of the ore to St. Louis. Would you believe it, that there are hundreds of tons of ore running say 30 ounces of silver, lying about on the dumps of the mines round Silverton as worthless? Such is the case. What do you suppose Greene & Co. gave for 100 ounce ore? Just $42.00 They are making a fortune each year; and they deserve to, for having the grit to bring all their machinery 180 miles by wagon and pack animals.

It has been estimated that here, within a radius of 20 miles, there are over six thousand silver claims which are only having yearly assessment work done on them, and all owing to the want of roads and smelt mills. The best proof of the want of them is the simple fact that here in the Sneffels district, whose ores are the richest yet discovered in the San Juan country, 100 ounce ore will not pay to work, and is not saleable at this writing.

But year by year a few capitalists find their way into the country, a mill or two goes up, and another road is built, and the time is not far distant (experts say two years), when the man who owns a mine with a pay streak of one foot of solid mineral running 50 ounces of silver to the ton, will be worth a million.

The Sneffels district is yet in its extreme infancy, but the wonderful richness of its ores has made its fame known all over the mining world. In this basin and the adjoining one there are thirteen mines being worked this winter, and the probable output of ore on the dump in the spring will be from one thousand to fourteen hundred tons, the yield of which will average between 150 and 175 ounces to the ton. Among these are the "Wheel of Fortune," whose first class ore has run as high as 800 ounces, the "Virginius" 230 ounces, and "Yankee Boy" 560 ounces. The greater proportion of the ores in this district are galena, carrying gray copper, and here the tetrahedrite is invariably highly argentiferous—in fact directly a miner finds it in his lode he is, as they express it, "eternally heeled."

Some few of the richest ores show proustite and stephanite in large quantities, notably the "Wheel of Fortune" and "Yankee Boy." As a class however, the ores are essentially smelting ores, but as yet we have no smelter nearer than Lake City, 37 miles by trail, or 110 by road, or at Silverton, 20 miles by trail, and it costs $45 per ton to pack to the former, and $20 to the latter place. There is every facility for a smelter here in the very centre of the mines, and a fortune to be made at it; splendid water power, 500 acres of pine timber, and more if wanted. But the right man has not come along yet.

With the close of the season of 1877, miners see a notable change in the San Juan region. It has grown solid. The day has passed when plucky, shiftless men, braving hunger, heat and cold, could come in here, find a claim, go out with a piece of the top-rock and sell the claim for a few hundred dollars. The prospector's reign is nearly over; prospect holes no longer find sale, and the only property men will look at is a developed mine. This is as it ought to be, and the best sign of coming real prosperity. It will clean out the horde of men calling themselves "miners," who have found good lodes, and who as long as they can by any artifice get a "grub-stake," sit at their cabin doors or round the bar-rooms of the nearest camp, with their pockets full of sample rock, waiting for the everlasting capitalist to come round the corner and buy them out at high figures.

There are easy fortunes to be made here in 1878, by three classes of men: First and foremost, by the smelter; and for the next ten years at least a smelt mill managed properly will make a moderate fortune each year.—There is no limit, you may say, to the possible output to ore in the San Juan country, and as soon as there is a market for the ores, the mines will be worked, of course. The smelter has, and will have for some time to come, a monopoly here; he gives the miner what he pleases for his ore and grows fat meanwhile; but it is the same story as with the building of toll-roads, the sure, safe and legitimate enterprise is thrown overboard for speculation. The man who comes in to build a mill, which he perhaps *does* understand, loses his head at the richness of the lodes and buys a mine which he does not understand, and waits for some one else to come and build the smelter to make it worth something.

Second:—The man of means who is a miner by profession, or experience, who will come here and look about him: He can get any amount of good silver lodes for a song,—and when I say "good silver lodes," I don't mean "prospect holes;" but mines that have been brought to a dividend paying condition. The reader will naturally say, "if the mine pays a dividend, why will the owner sell?" Well, this is a conundrum that I for one am bound to give up. But it seems to me the ruling passion among San Juan miners. They who are fortunate enough to get possession of a lode that will produce pay ore from the first shot, or nearly so, immediately lay down their tools and go to work to try to sell it, apparently losing sight of the fact that the mine would probably be a large annual income to them for life, and to their children's children. There are, of course, many reasons for this. A majority of the present mine owners are the pioneers of the country; men to whom $10.000 is a fortune and all the money they want. Another reason is because of the multiplicity of partners in the best mines and consequent dissensions. Another, because they are too lazy to work. Another, because they are lunatics. I maintain that the man who owns a good lode here and sells it, is nothing else; but their name is legion who will do so gladly.

Third: Young men, miners of grit and muscle, who are not afraid of hard work, and are possessed of a few hundred dollars—say a thousand dollars each—they can come here and get a lode to work, either by finding one, buying one, or getting an interest given them in one for doing a certain amount of work on it. Five hundred dollars will put up a cabin and stock it with grub, powder and fuse for eight months. But they must be prepared to undergo toil and hardship, heat and cold, and be able to be their own builder, carpenter, stone mason, cook, washer-woman and tailor; all these as well as miner.

None others need apply. There are no book-keepers wanted; no clerks, no artisans; loafers are soon starved out; gamblers have none but their own kind to prey upon and an occasional "tender-foot;" and "kid gloved" gentry generally, *et hoc genus omne*, had better stay away. The San Juan *working* miners as a class are sober, hardworking men, and hospitable to a degree; pistols are never carried here, except by "tender-feet," whom you will generally see coming in with their loins girt about with no end of ordnance. Drunkenness in the mining camp I have never seen (except on the Fourth of July,) and, in fact, our miner is, unlike those in most other mining districts, "a solid man." If any of your readers would like any further information about this wonderfully rich mineral belt, I shall be glad to give it through the editor of this periodical.

IMOGENE BASIN, INTERIOR SNEFFELS' MINING DISTRICT, NOV. 25, 1877.

FOREIGN CORRESPONDENCE.

PARIS, December 2, 1877.

The belief that the moon exercises an influence on our atmosphere is as old as tradition itself. Astronomers of late appear to maintain the contrary. M. Faye, for example, a most eminent authority, asserts that the moon is innocent of all changes in the weather, despite the experience of peasants and sailors. Now, there is much to be said on both sides, and the subject is perhaps not quite exhausted, as we shall see. If the moon, observe the generality of people, exercise an influence on the tides, why not on atmospheric currents, equally as movable? Now, the moon can only act by its attraction or its heat; bodies attract in proportion to their masses, etc., so that the moon ought less influence a lighter body, such as air, than a heavier, like water. The influence of the moon at the equator does not raise the water of the ocean more than 39 inches. What we call the tide, that is, where the sea rises from 20 to 50 feet along the coast lines, is not due to the action of the sun and moon, but to the mass of water rolling in from the ocean, bathing the shores and penetrating into recesses, and which being unable to find an issue proportionate to its volume, becomes, as it were, heaped up; increases in height, for what is lost in breadth is gained in elevation. The barometer does not register any appreciable difference in atmospheric currents, due to the moon's influence; when this satellite passes over our heads it lightens bodies one ten millionth part of their weight. The moon's heat is insignificant; according to Piazzi Smyth, only equal to that of a candle at a distance of 40 feet. So much for theory. It is a general opinion, prejudice, if you please, that the moon has an influence on the production of rain. Shrewd observers say more rain falls during the second, than pending any other quarter of the moon, and when the latter's orbit is near, than when distant from the earth. Arago, contrary to what is believed, confirms the popular opinion within certain limits. The effects of the moon are general; the same day that it rains at Paris, it is beautiful weather at Orleans—yet our satellite is the same for both cities. There are no storms at Lima, and never at St. Helena, the other side of the Atlantic, is thunder heard; there are peals of thunder every day in the Moluccas and the Sonde islands, yet the moon in these regions passes through its phases as with us, and the ocean rises or falls, following the moon.

It is known that the tides of our atmosphere are insignificant; even so, are they capable of producing rain and fine weather? Clearly, there can be no rain without water, and no matter to what altitude the moon might draw up the atmosphere, not a drop of rain could fall if it did not already exist there. Bear in mind a volume of air can only contain a quantity of watery vapor proportionate to a given pressure and temperature. If the air expands by heat, or contracts by cold, the excess of vapor falls as rain. Currents of air coming from the ocean are charged with watery vapor, while currents arriving from overland are the contrary; that is to say, dry. The action of he moon seems to reside in the displacement of these currents. Where dry currents predominate there can be no rain, no more than water could be expected from a pump sunk in a parched soil. The sun in its annual course, in passing from one hemisphere of the heavens to the other, drags with it all our atmosphere, not only displacing it, but altering also its currents. Thus the trade winds that reign in each atmosphere around the equator approach our latitudes in summer, and recede in winter. These semi-annual perturbations are represented by the equinoctial winds. As a kind of central furnace, the sun's influence is considerable on all our atmosphere; it produces annually displacements in currents. Why not the moon also induce monthly changes, as it passes from one hemisphere into the other, causing aërial currents to penetrate different regions? Our satellite ought to force back the northern on the approach of the southern winds, substituting thus rain for fine weather. Such is likely the mechanism of our satellites on the weather; so that it is neither a prejudice nor exactly a popular error to hold that a change of moon will be followed by a changement of weather, and that the moon can equally induce rainy or dry weather, in two neighboring regions, as the latter are situated on the confines of humid or dry currents. It is thus explained why rain falls at Paris, while there is brilliant sunshine at Orleans.

In Paris hydrophobia is unpleasantly on the increase. Every year the government publishes returns of the number of persons bitten by mad dogs. Dr. Proust has examined all these statistics for the last thirty years, and has arrived at important conclusions. Thus: men are more frequently bitten than women, and children more than either. The latter is due to dogs being so often their playmates, and that children are constantly outside of doors, whether in towns or villages. But if attacked by mad dogs, children are more exempt from the consequences; of 154 individuals bitten between the ages of five and fifteen, only 37 died, whereas of 32 persons attacked, and aged between sixty-one and seventy, 22 succumbed. Dr. Proust also establishes that there are no "dog days," as the animals have no special season for the *rabies;* the maximum of registered bites took place, not in July, but in September and February; the minimum in March and August. Hence, the police regulations respecting dogs onght to be as active in winter as during summer. Cauterization, following the same authority, is the only known remedy against hydrophobia. Of 203 persons bitten, sixty per cent. died; when cauterization has been resorted to, or butter of antimony employed, immediately after being bitten, the death rate was only twenty per cent. It is difficult to have a red-hot iron, &c., ready at hand, so the doctor recommends tightly bandaging above the wound with a piece of cord, or a cravat, &c. This interrupts the circulation of the blood, and diminishes absorption—ordinarily very rapid, of the virus deposited in the flesh by the dog's teeth. The bleeding from the wound, by the well-tightened ligature, will be increased, and add to the chances of the virus being discharged; of course the burning is to be applied subsequently. M. Mennerson has employed electricity to calm the spasms in a young veterinary surgeon afflicted with hydrophobia, when chloroform failed to produce relief—in fact the anæsthetic only augmented the spasms; he applied the wires to the back of the neck and the soles of the feet; immediately tranquility ensued; the patient could eat, drink and talk; the sight of liquids did not agitate him. Unable, however, to support the continued action of the current, electricity was discontinued; the spasms returned, more violent than ever, and later, the heart suddenly stopped. Dr. Proust alleges instances where mad dogs had so little horror of water that they swam across rivers to attack sheep on the other side. M. Bourrel urges that the incisor teeth of dogs ought to be filed; thus blunted, they could not readily penetrate the flesh.

Dr. Delaunay has concluded a long series of experiments on the relative volume of heads. As a rule, he finds that persons possessing the largest heads are generally occupied in scientific pursuits. He has measured the heads of soldiers, officers, doctors, trades-people and workmen, and has obtained statistics from hatters to various colleges, and in a sense, furnishers to several classes of society. Dr. Delaunay concludes that engineers have larger heads than military officers; the latter more voluminous than privates. Religious persons are distinguished for their small heads; thus the inmates of St. Sulpice College, where the clergy are trained, are in this respect behind the Normal school, where university lay professors graduate. It is in the scholastic quarter of Paris, that hatters record the largest measurement of heads. Merchants would seem to come next, and then in order of rotation, tradesmen, the aristocracy, artisans, laborers, and rag pickers. Masons' heads are proverbial for their small volume. Also, the head, it is alleged, grows from intellectual exercise, perhaps as the muscles from work, and it is an observed fact, that peasants who immigrate from rural districts to cities undergo a gradual enlargement of the head.

The Academy of Sciences has since many years been occupied with the subject of localization of the brain. As many forms of paralysis correspond with lesions in the gray substance of the brain, and since the exact position of such substance can be localized, M. Baurdon recommends the operation of trepanning, thus laying bare the affected substance and treating it as a fatal abscess. He is also of the opinion that when some brain ailment disappears it is not in consequence of the lesion ceasing to exist, but to the white, replacing the functions of the gray matter of the brain.

The Messrs. Tissandier in their recent balloon ascension observed a few curious facts. The balloon rose in the afternoon, the weather being very beautiful; at the height of 440 yards there was a feeble current of air from east to west; at double this altitude there was moving in the same direction a very violent current; at 250 yards higher the atmosphere was perfectly calm. This rapid stratum of air between two motionless layers is a rare circumstance. At the altitude of 1,200 yards the temperature was only 53° Fahrenheit, while the sun's rays were scorching. At 880 yards the atmosphere was full of "virgin's threads," which are only agglomerations of spider's threads, thus attesting how solar heat, or atmospheric movements, can whirl up light substances.

M. Breguet has brought the telephone, or speaking telegraph, under the notice of the Academy. The apparatus is simplicity itself—a small circular plate of thin metal, vibrating in presence of a magnetic bar; by means of a little bobbin of fine metallic thread, on the extremity of the bar, are communicated these currents of vibration to an identical apparatus situated at a distance more or less great. The French *savants* rather appeared to forget that the most extraordinary fact about the discovery is the value of the idea—that sound can be telegraphed distinctly, thus opening up a world of industrial applications. Hardly have the conducting powers of tubing being employed for speaking directly between two houses, or throughout vast buildings, when the *telegraphe parlant* is announced to supercede it. M. Breguet stated that not the least astonishing property of the marvelous new invention is, that of all telegraphs known, it functions under the influence of the most feeble currents. Further, he announced that after interlacing the sound in a resistance equal to a distance of 1,000 kilometres of ordinary telegraphic wire, he was able to hear phrases most distinctly, that is to say 625 miles. The apparatus collects, transmits and receives the sound of the voice. What a field is here opened for the imagination! Communications exchanged, irrespective of distance, with the living and personal character of voice, instead of the cold written representation of thought. The first metal disc indirectly produces the currents, and the latter develops, also indirectly, the vibrations in the second disc. It has been objected that the second plate in vibrating symmetrically, while emitting the same sound, does not produce the same volume. The currents are thus modified in their course. This may explain why the tone of the voice has failed to be "wired." Tone is but the superposition of a certain number of sounds upon a fundamental sound; a kind of very complicated mixture. The sound "received," as compared with that "dispatched," was alleged by some academicians, as a painted photograph of a painting to the painting itself. The results may be different when Mr. Bell conducts the experiments. The discovery with all its imperfections is not the less astonishing. What progress since the celebrated "ear" of Dionysius of Syracuse?

M. Rodier draws attention to the fact that submerged aquatic plants have the property of spontaneous movement. In June last he watched this rotation, which attained to 45 degrees. During the night the same plants turned in an inverse direction. M. Cornu has conducted some experiments to show that in the case of inferior plants, the spores of ferns for example, it is to the influence of oxygen, that the putting in liberty of their reproductive bodies, is due.

M. Bechamp has devoted attention to the subject of musty eggs. He finds that hen eggs can be enclosed for twelve months in a vessel filled with infusoria, without the animalcules ever being able to pass through the shell; but the same is not true respecting the microscopic spores of must. M. Pasteur has shown that the elements of decomposition can exist in the egg itself, in consequence of foreign bodies being present in the ovary of the bird.

M. Westphal, a German doctor, applies the term *agoraphobia*—fear of public places, to the nervous malady some persons experience when they quit the foot-path to cross a busy roadway. Benedickt attributes the disease to confused visual sensations; Perroud and du Saulle, to the fear of a void or the dread of space, and that the arm of a passer-by, or following behind a vehicle, relieves. F. C.

GEOLOGY AND MINERALOGY.

MISSOURI IRON ORES OF THE CARBONIFEROUS AGE.

BY G. C. BROADHEAD, PLEASANT HILL, MO.

The various Iron Ores of Missouri have been extensively treated of in the Geological Reports of the State. Those of central and part of southeast Missouri in the volume of 1872. Others of southeast Missouri in the volume of 1874. But these reports have been mainly confined to ores occurring in the rocks older than the carboniferous. The ores heretofore worked in Missouri, belong either to the lower Silurian rocks or the Archæan; the exception is the opening of a few pits of Red Hematite in Callaway County.

Although our Carboniferous ores have been neglected, we nevertheless consider them by no means unimportant. To be sure, many of them are quite impure, but an advantage they possess over the other ores is, that they are easily mined and broken, and that many of them have sufficient limestone associated with them to render any other fluxes unnecessary. The ores in the older rocks are generally definite deposits, or as foreign developments in either regularly stratified or unstratified rocks. But the carboniferous deposits from regular geological strata, prevailed with the stratification of the associated rocks.

LOWER CARBONIFEROUS ORES.

These are found in large masses and good quality in Benton, Henry, Dade, Cedar, Green, Christian and Lawrence counties in Southwest Missouri, and may be referred to the age of the Ferruginous sandstone of the Missouri Geologists which is probably a member of the Chester group of Southern Illinois.

In Christian county, in S. E. S. E., Sec. 24, Tp. 27, R. 24, are found large masses of fibrous limonite. A shaft proved it to be over eight feet thick. In Sec. 19, Tp. 27, R. 23, are also large beds of the same kind of ore; also, in Sec. 7 of the same Township and Sec. 14 and 15, Tp. 27, R. 24. The lower caboniferous sandstones of Lawrence, Dade and Cedar counties are very ferruginous, and may prove to contain valuable deposits of iron ore. Dr. A. Schmidt, in Mo. Geol. Rept. 1872, speaks of iron ore banks in St. Clair and Henry counties that are undoubtedly referable to the sub-carboniferous age. The Brown bank in Sec. 23, Tp. 40, R. 24, in Henry county, on dividing ridge between Osage and Grand rivers. The ore is red, earthy hematite, partly changed into brown and yellow limonite, and associated with ferruginous sandstone.

The Collins bank in Sec. 23, Tp. 39, R. 25, St. Clair county, is an outcrop of red, earthy hematite. A very good deposit is, apparently the Marmaduke bank in Sec. 23, Tp. 39. R. 25, in St. Clair county. The ore is an earthy red hematite and a yellowish brown porous limonite. At many places in the Southern portion of Callaway county, are exposures of red hematite which appears to belong to the age of the sub-carboniferous. The following were the chief localities observed: Sec. 22, Tp. 45, R 10. Shaft hill in N. W. qr Sec. 4. Tp. 45, R. 10, has been worked, and the ore undoubtedly passes horizontally (or nearly so) through a hill of 800 feet diameter, the ore seam varying from one to five feet, is sometimes in regular layers, at other places in nodules or lenticular concretions. A section of the hill appears thus: From top:

1. Flint.
2. Red hematite.
3. Sandstone.
4. Conglomerate of Flint and Sandstone.
5. Sandstone.
6. Encrinital Limestone.

There is another on bank on Section N. Others also, three miles north of New Bloomfield on the Fulton road. In Sec. 42, Tp. 46, R. 10, there is also a fine outcrop of dense and fine grained red hematite. The ore here is two feet thick, dipping 20 deg. north.

Near Holt's Summit are similar outcrops of stratified red hematite.

Similar ore beds of sub-carboniferous age occur in Boone, Montgomery, Warren and Lincoln, some of them, forming good beds of red ochre, or as commonly called, "red keel."

The following are analysis of New Bloomfield ores:

	Compact Variety.	Earthy Variety.
Metallic Iron	63.87	61. 17.
Silica	5.80	8. 63.
Phosphoric Acid	0.10	0.165
Sulphur	0.017	0.018

UPPER CARBONIFEROUS ORES.

These ores exist in regular layers, interstratified with coal and shale beds, and lie chiefly in a horizontal position. They include three principal varieties: The impure carbonate or clay ironstone, the red hematites, and the limonites. They are more commonly found and in thicker layers in the lower coal measures.

CLAY IRONSTONE.

In the middle and upper coal measures, there are occasionally found thin bands of ore, but they do not often exceed two inches in thickness, and rarely are there as many as two layers found in near proximity. The lower measures often abound in bands and concretions of this ore, and although not often over two inches thick, yet are sometimes as much as four inches. We may also generally expect to find several layers within a few feet of vertical distance.

In Johnson county, on the banks of Clear Fork, five miles Southeast of Knob Noster were observed two layers of ironstone, each of one foot thickness and separated by one foot of clay shales; over the uppermost ironstone bed rested four feet of sandy shales inclosing concretions of ironstone, all amounting to three feet thickness of ore inclosed in seven feet of soft shales. Thirty feet below, there lies a bed of good coal, varying from two to three feet in thickness. Twenty feet above the ironstone beds, there rests another coal bed of one to one and a half feet thickness, with still another of one foot, lying twelve feet higher. Here are both coal and iron ore together—important facts for consideration. Similar ore beds and apparently a continuation of these, are exposed on Clear Fork about ten miles north. Between the two outcrops, and under Knob Noster and its vicinity, there lies a good bed of yellow ochre, varying in thickness from two to five feet.

On Grand River, near Little Compton, Carroll county, similar beds are exposed, lying horizontally, and separated by soft clay shales. The ironstone beds are here included within a vertical thickness of thirteen feet of clay shales, and amount in all, to over two feet in thickness. A one and a half foot seam occurs in the bluffs above. Three miles east of Clinton, Henry county, the shale beds contain concretionary forms of ironstone in large masses. Similar ore, quite fossiliferous, seems quite abundant at Gilkerson's ford on Grand River. Two good coal beds also lie in the same bluffs. We predict that at some future time, this locality will become important. Other important localities are at Timbered Mound and on Marmaton north of Nevada, Vernon county, the western part of Cedar county, on Panther Creek, Bates county, near Rockville, and on the same creek a few miles north.

In the northwest corner of Jasper there appears a two inch band of poor quality of clay ironstone, which contains much iron pyrites. The owner thereof confidently believed the rock to contain silver and had commenced the construction of works to reduce the ore. He was not inclined to accept our advice against such foolish expenditure of time and labor.

All of the above coal measure ores are impure carbonates, and will yield from 30 to 40 per cent. of metallic iron. An ochreous crust is often found on the exposed surface. The layers are often jointed, the joints lined with calcite and sometimes with a thin plate of pyrite or zinc blend.

RED HEMATITES.

These occur either as open porous ores, as ochres, or as hard, close grained ores.

In Linn, Sullivan and Adair counties there occurs from ten to fifteen feet of red shales, soft and smooth feeling, which in many places include nodules of hard close-grained ore, varying in size from quite small to pieces three or four inches in length and two inches thick ; their prevailing shape being roundish elongated. A fracture often exposes minute seams of carbonate of lime, which, especially partly compose the remains of fossils, of which a few well recognized coal measures species were observed, including *Discina nitida* and *Myalina Swallowvii.* Near Linneus, and also on Locust creek and Spring creek, three miles southeast of Laclede these nodules are quite abundant. On Locust creek and Spring creek, Sullivan county, and at many places in Adair, also in the eastern part of Linn, these red shales prevail and are quite ferruginous and would undoubtedly form a good paint, yet the ore nodules are small and not so abundant. An analysis of a nodule from Garretts, near Linneus, by Mr. Chauvenet, gave sixty-two per cent. of metallic iron. Near Calhoun, in Henry county, red hematite occurs as a porous ore of apparently good quality, and soft enough to be easily crushed. The bed is about five feet thick, and underlies nearly ten acres of ground. It is overlaid by a few feet of loose nodules of kidney ore dispersed through the shales.

We also find, both at Clinton and Calhoun, Henry county, a six inch band of red hematite, quite fossiliferous. The evidence is, that this ore has been altered from a limestone nucleus with a ferruginous crust of red and brown ochre. At Calhoun, the interior is of an ash drab, next a half inch red band, then a half to three quarter inch of alternations of red and brown with brown exterior. At Clinton, it is deep red throughout. The fossils contained are typical of coal measures, and are: *Productus Mervicatus, Pr. prattenianus, Hemipronites crassus, Chonetes mesoloba. Ch. Verneuilliana, Spirifer planconvexus*, and *Discina.*

LIMONITES.

The Limonites are either hard or soft, brown or yellowish. The Knob

Noster bed previously spoken of, was traced for several miles, and found to underlie not less than five square miles. It varies from a lean, yellow ochre to a richer, and was also found as a firm, hardened limonite of good quality. Further examinations showed it to be originally a ferruginous fire-clay, containing the well known *stigmaria ficoides*. Four feet above it lies a 16-inch coal bed.

Beds of limonite are of common occurrence in the eastern part of Vernon, and are also found at many places in Barton. Ochrey and concretionary beds overlie a certain coal near Calhoun, Henry county. But the best exposure was observed in the southwest part of Cedar county, where are two beds of good limonite ore, one bed of red ochre and a bed of coal, all occurring in the same section thus:

1.—Hilltop and slope.
2.—28 feet of sandstone.
3.—5 feet of porous limonite.
4.—1½ feet of soft, reddish brown limonite, with coal plants.
5.—7 inches of ochre.
6.—4 inches of red sandy shale.
7.—1 foot of sandstone.
8.—6 inches of coal.

No. 3 of this section, according to Mr. Chauvenet, yielded fifty-seven per cent. metallic iron; No. 4 yielded fifty-four and eighty one-hundredths per cent. These ores occur in regular horizontal layers, extending into the hill, and do certainly underlie much of the neighboring country, and being soft are easy to take out. Besides the six inch coal seam there are other thicker beds in the vicinity.

If we compare the analyses of these ores with similar ones of Indiana, Pennsylvania or Ohio, we find ours are equally as good, and while the main working ores of those States will not average over 35 per cent. of metallic iron, and some are worked that contain less than 30 per cent., and but few reach as high as 45.

A clay iron stone from Barton county, Mo., yielded 33 per cent.; another 44; our brown hematites 53 and 58, and red hematites have even yielded as high as 62 per cent. of metallic iron. We have many bands of ore that will yield from 25 to 35 per cent., and there are many other thin strata that I have not mentioned in this article.

FOSSIL LEAVES IN KANSAS.

The Kansas Academy of Science at its late meeting adopted the following resolution:

Resolved, That a committee to be composed of three members of this body be appointed, whose duty it shall be to promote, by all proper means, a diffusion of a knowledge of the facts of elementary science in respect to their application to the affairs of common life; and to encourage among the people the investigation, especially, of matters pertaining to Kansas.

Prof. Mudge, as a member of the committee, has prepared the following paper relating to Kansas geology:

"There is a deposit of red sandstone in Kansas, extending from Republic county on the north line of the State, to Reno county in the Arkansas valley, which contains most interesting fossil leaves. This rock deposit is more recent in the order of construction of our earth's crust, than Hugh Miller's Red Sandstone. It is of the lowest cretaceous age, having been deposited just above our Kansas upper carboniferous rocks. Many of the leaves in this sandstone are very distinct, showing even the finest veins and markings. Among them are found the oak, willow, hickory, poplar, beech, sassafras, maple, birch, laurel, plum and apple, besides many small shrubs. In addition we find the palm, fig, cinnamon and magnolia, now so common in in warmer countries. Occasionally we discover in the same sandstone salt water shells.

The occurrence of tropical plants, is explained by the facts which show that the vegetation grew on islands in the middle of the ocean, which contained warm currents, like the present Gulf Stream, which kept a mild land temperature. It is also probable that the palm, fig, and cinnamon were hardy species of their kind, which would withstand a little more cold than those now living.

The most instructive feature of those fossil leaves to the geologist is, that they are the first plants of the high family of dicotyledons, or plants with net veined leaves and with an annual ring of growth on the trunk. They embrace all the common forest and fruit trees of the temperate zones excepting the pines and other evergreens. Botanists class them as the only trees of high rank, having true flowers and fruit.

Previously to this time, in all the older deposits, no plants of higher organization can be found, though careful search has been been made by geologists in all parts of the world. Pines, which are classified near the middle rank, have been long known as three times as old, geologically considered. Ferns and many other flowerless plants are found, but not as old as the pines. The first palms, though considered in the lowest rank of trees, came in with our net-veined leaves of Kansas, the two extremes of tree vegetation appearing here at the same age of the world. The palms are placed by botanists as the lowest trees, far below the pines.

About one hundred of the net-veined leaves have been found in Kansas and Nebraska. The total thickness of the deposit containing them is less than 500 feet.

Here is something for the Darwinists to consider. All these varied and modern trees are found coming into existence suddenly, with all the various types which grow in our forests to-day. No trace of any grade from which they could have been derived can be discovered, though carefully sought, both here and in other parts of the world. According to Darwin, the low vegetation should have appeared first, and gradually merged into the highest type, and the latter seen only in the most recent deposits. But these from the lowest part of the Cretaceous are almost identical with those now living and some entirely so.

ARCHÆOLOGY.

EPHESUS, CYPRUS, AND MYCENÆ.*

BY BAYARD TAYLOR.

Side by side with the splendid achievements in physical science which distinguish our generation, must be placed the results of archæological research. The two forms of labor are not necessarily connected or independent, yet they have been equally stimulated by a common experience in detecting possibilities of entrance—often slight and inconspicuous posterns, discoverable rather to the eye of faith than to that of knowledge—in barriers which once seemed hopelessly closed. It is not so very long since the complete or at least formless ruin of the great cities and edifices of antiquity was a generally-accepted belief: the phrase "not one stone shall be left upon another" was supposed to express a literal fact; the lost languages were given up as lost; and the unrecorded histories were never meant to be restored. Now scarcely a year passes without the discovery of some important historical landmark, and every new light of knowledge, illuminating the remote past of our race, reveals the dim outlines of a still remoter past behind it. As one climbing a long mountain-slope, we see farther backward in proportion as we rise.

The great age of archæological discovery began with Layard's excavations on the site of Nineveh, and the researches of Sir Charles Fellowes in Caria and Lycia. Soon afterward M. Mariette, carrying a similar faith and enthusiasm to Egypt, found Memphis, and entered upon that long series of successes which has not yet come to an end. The race of explorers immediately begat a race of scholars: new Egyptologists appeared, and enforced their claims to honor and authority; Assyriologists for the first time came into being; and George Smith found history and religion on the dumb tablets exhumed by Layard. His own later researches at Nineveh; the excavations on the Palatine Hill, in Rome; Mariette's discovery of the statues of the Shepherd kings at Tanis; Schliemann in the Troad and at Mycenæ; Wood at Ephesus; Cesnola in Cyprus; and Curtius at Olympia—to say nothing of such minor research as that of the Austrian Government at

* We give the following extracts from a very interesting article in the last *North American Review*, upon the labors of Wood at Ephesus, Cesnola in Cyprus, and Schliemann at Mycenæ, by the distinguished traveler and author, Bayard Taylor, in order that our readers may have the benefit of his opinion of the value of the theories put forth by these enthusiastic discoverers; especially those of the last two, from whose letters and reports we have quoted so freely within the past year.—[ED.

Samothrace, Davis at Carthage, and Burton in the land of Midian—constitute a body of discovery of such vast importance and absorbing interest, that the civilized world seems scarcely yet fully to credit its possession. It is a skeptical age, and, when it sees so many men, who at first sight appear to be guided only by an intense, unreasoning belief in their object, actually finding what they sought, the natural tendency is to doubt and question and seek for antagonistic views. All the precious material so recently acquired must first be classified and relegated to its proper place in our ordered knowledge of the human past, before the world shall clearly recognize its importance. Its influence on the class of intelligent thinkers is already very perceptible.

Almost every one of the great discoveries I have enumerated has been due to faith in the trustworthiness of the ancient authorities. Since Herodotus and Ptolemy, so long suspected of having been fabulists, have been wholly rehabilitated as careful and conscientious guides, Strabo, Pliny, Pausanias—indeed all descriptive passages of classic authors—receive an authentic stamp, which they scarcely possessed before. But the belief which instigated such labors and trials of patience as every explorer must undergo, was not a mere uninstructed enthusiasm. Mr. Wood believed that there had been a Temple of Diana at Ephesus, and hence that its remains were not past finding out; General di Cesnola believed that there had been stately temples at Idalium, Golgos, Amathus, and Paphos; and Dr. Schliemann, in turning to prehistoric Mycenæ, depended far more upon the statement of Pausanias than upon the strophes of Æschylus. Although in the story of each there may seem to be an element of lucky accident, it will prove to be hardly more than the luck which, in the end, rewards persistent enthusiasm. There was a point in the labors of each when a doubting explorer would have stopped short, discouraged; and the triumph lay beyond that point. The narratives of the three last-named archæologists have appeared during the past year, and they form, in conjunction with Dr. Hirschfeld's report on the explorations at Olympia, such a contribution of recovered knowledge as should make the year forever memorable.

Beginning with Mr. Wood's first excavations at Ephesus, in 1863, and closing with Dr. Schliemann's discovery of the royal tombs at Mycenæ in November, 1876, the labors of the three gentlemen are included within a period of thirteen years. Their tasks were wholly distinct in character, and their methods of labor, therefore, had but a general resemblance. Mr. Wood's was the simplest, his one aim being to discover the Temple of Diana, the situation of which was indicated by nothing upon the present surface of the soil. Dr. Schliemann's was the easiest, since his explorations were fixed within circumscribed and rather contracted limits; and General di Cesnola's was, at the same time, the most arduous, and the most uncertain in its probable results.

I shall take the three in the order of their labors, and endeavor to detach, in each case, the clear and simple story from the somewhat irregular mixture of personal narrative, description of objects, and antiquarian conjectures, which we find in the volumes. By adding thereto a statement of results, with impartial reference to the character of the objects discovered, I may be able to furnish the reader with the necessary basis of fact, and qualify him to examine, with some degree of independence, the conflicting theories which seek to establish themselves thereon. The spoils of Cyprus and Mycenæ, as will be seen, are too new and unexpected to be readily disposed of, even by the most experienced scholars. In order to make room for them, the old adjustment of epochs in the art and general culture of the ancients must be materially changed; and the archæologists are almost as unwilling to accept such changes as are the theologians. Least of all, have they the right to disparage the enthusiasm of the explorer, over-credulous though it be; for to that enthusiasm they owe the achievements recorded in these three works. There are not many book-scholars who would have labored at Ephesus for years before grasping the clew which led Mr. Wood to the Temple of Diana: still fewer would have dreamed of digging at Mycenæ, with the expectation of finding anything beyond the foundations of Cyclopean walls; and in 1862, more than three years before General di Cesnola reached Cyprus, the French archæologist, Count de Vogüé, makes this report of his researches: "Quant à l'exploration extérieure de l'île, je puis le dire, elle a été aussi complète que possible; *rien d'apparent n'a été omis.*" It is, perhaps, not in human nature that a man of distinguished learning shall find that a favorite theory, upon which he has lavished years of thought, is jarred and in danger of being overthrown, without jealously defending it; yet it is curious to notice what immediate receptance any discovery obtains which seems to establish a point in what is called sacred history, and how much doubt and discussion follow the evidences of a fact underlying some episode of the semi-mythical age of profane history. * * * * * * * * * *

No theory has been changed, nor any new question raised, by Mr. Wood's success. He has worked upon purely historical ground, and the ancient authorities are his best witnesses. No one has disputed the solid marble evidence which he has brought to light; and the main lesson to be drawn from his labor is that complete destruction is a more difficult task than has heretofore been supposed—that the simple processes of Nature almost invariably hide some fragment of that which war or fanaticism would annihilate, and protect it for the believing explorer who may come two or three thousand years afterward. The only possible contribution to a more ancient period of art, which Mr. Wood may have furnished, is found in some fragments of sculpture, which Mr. Newton considers archaic, excavated near the lowest step of the temple. Their resemblance to some of the objects found by General di Cesnola in Cyprus is noticed by the distinguished archæologist, but a more careful examination and comparison are necessary before their character can be approximately determined.

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It is difficult to assign an exact place, either in history or art, to Cesnola's discoveries. He uses the general term "Cypriote" to designate them, in contradistinction to the Egyptian, Assyrian, and archaic Grecian elements which are combined in so many of the objects : this term must suffice until scholars are able to separate, or at least classify, the latter, and determine something in regard to their historical precedence. Already Mr. Newton and Mr. A. S. Murray appear to diverge somewhat in their estimates of the age of the pottery, while both are disinclined to attach much weight to the far greater antiquity of the fictile art in Egypt and Assyria. Every advance into the prehistoric past awakes a natural, perhaps unconscious tendency, both to shorten the successive periods of civilization and to attach a certain symbolism of faith to forms which may have descended into mere conventional use. Yet the position of Cyprus, visible from the shores of Syria (Phœnicia) and Cilicia, must have led to its settlement many centuries before it was conquered by Thothmes III. about 1600 B. C. This is the first historic mention of the island, and if one of the statues found at Golgos should prove to be, as is surmised, that of the Egyptian king, it cannot reasonably be ascribed to a later period. Greek immigration, subjection to Phœnicia, Assyria, Persia, and again to Egypt, succeeded during the next thousand years, leaving those mingled traces which make the Cesnola collection, in this particular, the most remarkable in the world. A very curious circumstance, and one which may throw some light on the simultaneous use of emblems belonging to several different faiths, is the separation of the many statues of Golgos into groups, according to their nationality. It is almost the only instance, in archæology, where the latter rule has not sought to destroy or mutilate the tokens of the earlier.

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Since the publication of Dr. Schliemann's work, I have re-examined the greater portion of the objects in the Cesnola collection, in the Metropolitan Museum; and I have been surprised to find so many of them identical with those found by Schliemann at Mycenæ. The diadems of gold-leaf, the wreaths of laurel-leaves, the golden buttons (some of them showing exactly the same ornamental patterns, in *repoussé* work), the bronze hatchets and sword-blades, are not to be distinguished from the same objects among the Mycenæan spoils; while there is scarcely a type of pottery, or a form of the rude terra-cotta idols, contained in the latter, which is not matched by something from Idalium, Golgos, or Curium. When we add thereto the similar objects from what Schliemann styles the pre-Trojan city at Hissarlik, and the Rhodian vases from Ialysus, we find ourselves face to face with one and the same school of ceramic and decorative art. The inference which might be drawn from this fact seems to conflict with former historical theories. Certainly the same race could not have possessed these separated shores and islands at the same time, nor could one divinity (however related, as we know, were the ancient theologies) have received the same honor in each place. We are thus led to accept the existence of conventional forms and decorative patterns in art, and to trace them to what was undoubtedly their primal source—Egypt and Assyria. Here another question arises, which the professsional archæologists do not seem to have adequately considered. At what phase of human civilization does the fictile art make its appearance? From the evidence of our ancient mounds in this country, it is the first step from barbarism to the beginning of civilization, and thus almost the oldest of the rude mechanic arts. Hence, in Phœnicia, its introduction must have speedily followed its invention in Egypt, which was nearer 4000 B. C. than 3000 B. C., while in Assyria its antiquity can hardly be ascribed to a later than the latter date. How long would the neighboring island of Cyprus remain ignorant of so useful an art? and how much more time would be required to carry it to Rhodes, the Peloponnesus and the Troad? Evidently, the age granted by certain scholars to the oldest specimens of Cypriote pottery—about 800 B. C.—and that allowed to the relics from Mycenæ, two or three centuries earlier, does not indicate, even if correct, the period when the art was first brought into practice, in either locality. The term "prehistoric" must not be understood, therefore, simply as designating that cruder form of civilization which has not yet learned to preserve and transmit its records to the succeeding generations. It indicates, at best, in the Hellenic past, the ages of which the exact records have been lost, when no era had been fixed for the computation of years, and, as a natural consequence, the primitive mythical history had become confounded with later historical facts.

Dr. Schliemann's discovery at Mycenæ has the advantage of whatever probability belongs to this view. All our recent explorations of the past of the human race, all the amazing discoveries of the last thirty years, establish more firmly the fact that a basis of actual historic truth underlies every feature of ancient history which we have been accustomed to consider mythical. The opposite views which prevail, it is evident, arise chiefly from the reluctance of scholars to accept any inference which may conflict with the Hebrew chronology. Forgetting that far older and mightier empires, with far earlier records, existed on both sides of Palestine, and left their stamp on its political and hierarchical organization, even on its supreme faith, they waste much labor in constructing defensive theories, instead of reasoning backward from independent evidence. It is simply impossible that two such powers as Egypt and Assyria should have existed, without stimulating all the neighboring races which possessed the least capacity for development. We do not find such phenomena in the world now, and there is no reason for believing that they ever occurred. Speaking as a layman, without the shadow of a claim to authority, I find it exceedingly difficult to believe that in the time of Homer, when Egypt had possessed a written language for at least two thousand years, the Greeks, with the development in art and political organization which they then enjoyed, should not have had some form of alphabet. It is equally difficult to believe that the *rhapsodes* transmitted the "Iliad," orally, for centuries without falling from its even heroic strain to meet the comprehension of promiscuous assemblages of hearers. Either the Greeks were stubborn barbarians at the epoch of the Trojan war, or they gave no token, then, of the inventive and independent genius which, a few centuries afterward, made them an immortal, an almost ideal race, for all succeeding ages.

But if, on the one hand, the accepted views in regard to the scope and character of the early Hellenic culture may be false, on the other hand these recent explorations suggest, even to the most skeptical, the truth underlying the heroic myths. Whether or not Hissarlik be the site of Troy, it is at least that of a prehistoric city, which was destroyed by fire. The coincidence of the art, and especially the mortuary ornaments and modes of sepulture, discovered at Mycenæ and in Cyprus, may or may not prove that the same race at one time inhabited both: the diadems and laurel-crowns may be no indication of royal rank; but the location of the tombs in the Agora is a certain evidence of the distinction in which the dead were held, and at least five of the latter must have been buried at the same time. We have thus the fact of slaughter, or war, followed by posthumous honor, and transmitted in the tradition of Agamemnon repeated by Pausanias. Dr. Schliemann's discoveries do not turn Æschylus into history, but they furnish a remote historic basis for the tragedy. In Cyprus, the bracelets of King Etevander and the inscription on the Assyrian cylinder establish each other's veracity, even as the record of Sennacherib at Nineveh and the Hebrew statement of the tribute paid by King Hezekiah. The human brain is not skilled in the art of inventing history without material. Some of the most monstrous legends have been finally traced to an intelligible origin; and it is scarcely possible that the large frame of geographical and ethnological truth, inclosed by the "Iliad," should have been peopled by merely imaginary figures, and made the scene of imaginary deeds.

DISCOVERIES AT OLYMPIA.

According to the instructions received from the directing committee at Berlin, the first aim of the operations conducted this year by the new chief of the German expedition at Olympia, Dr. George Treu, has been to continue and complete the clearance of the ground already excavated in front of either end of the Temple of Zeus. Rich successes have already rewarded those renewed labors. On the eastern side, the demolition of the walls of the Byzantine settlement has yielded a large number of fragments, but most of them small, and among them only one which could be immediately identified as belonging to the sculptors of the pediment group; this was a part of the helmet of Oenomaus.

Another wall, however, in the same neighborhood, but further north, starting from the second column of the east front of the Heraeum, and composed of indiscriminate fragments of columns and figures, has yielded three draped statues of the Roman period, all found within a distance of twenty feet. These are complete but for the heads; two of them are female figures, and bear the names of Athenian workmen—Eros and Aulos Sertous Eraton—these were found on October 29. The third, a male figure, only came to light on November 14th, and, at the time of our advices, was not sufficiently extricated to make it certain whether it bore an inscription or not.

But by far the most important of the discoveries has been made in the diggings to the west of the temple. These, taking them in chronological order, have been as follows: On October 19th the middle portion of one of the groups of Centaurs and Lapith women from the pediment of Alkamenes; this fits with two other splendid fragments found last season, and gives us the group almost complete. The Centaur has grasped the Lapith maiden with his left arm, and thrown both his fore legs about her; she has seized the ravisher by the beard, and strives hard to force his drunken head away from her. It is remarkable that while the upper portion of the group was found in the most northerly situation of all last season's discoveries, the new portion lay more than fifty yards off, at a distance of about thirty yards west and southwest of the southwest angle of the temple.

On October 23 there followed a still more fortunate find—that of the whole body, wanting only the right arm and legs below the knee, of the beautiful somewhat archaic Apollo, who occupied the middle place of the pediment among the combatants, and whose head only had been found last year. On October 26 there came to light the head of a Centaur, somewhat injured, but full of character and of great interest, because it serves to complete the group corresponding to that last described, which had its plaee next to the Apollo on the other side, and which is supposed to represent the bride Deldamia and her assailant. Several holes round the head of the Centaur show that he is represented as wearing a reveller's garland, probably of bronze. A few more hands and feet are all the additional finds that belong to the pediment sculptures.

But on October 23 an important piece of another kind was discovered in the shape of an archaic bronze head, about six inches high, intact, wearing beard and mustache, and having the hair treated in long plaited locks on the shoulders, and two rows of conventional ringlets over the forehead. Lastly, and to the student of archæology perhaps most interesting of all, a large bronze plate measuring eighty-five centimeters at the top and twenty-six at the bottom.

This unique specimen of art is wrought with four rows of figures in relief, in an extremely archaic style corresponding to that of the earliest so-called Corinthian vases, and, as we may infer from the description of Pausanias, to that of the chest of Cypselos. In the lowest compartment appears a four-winged female figure, who in either hand holds up a lion by the foot; in the second, Herakles, as a kneeling archer, shooting a flying Centaur, and without his later attributes of the lion's hide any club; in the third compartment upward, two griffins facing one another, and in the uppermost compartment two eagles. It can not be doubted that this, the first discovery of its kind made at Olympia, is destined to furnish an invaluable link in the study—for which the materials are only now beginning to be collected and compared—of the origins of the Greek art.—*Academy.*

ASTRONOMY.

SUN SPOTS AND THEIR EFFECTS.

The phenomena of sun spots are now familiar: multitudes of people have seen them, and everybody has read about them. It is well known that the surface of the sun is not that uniform disk of light that it was formerly supposed to be, but abounds in gulfs, dark chasms, up-rushing streams of flaming gases, and lurid prominences, sometimes 100,000 miles high. But these striking effects are not uniform: the sea of solar fire like our two oceans, is sometimes violently agitated and sometimes quiet. The spots are variable, being now many and enormous in size, and again few and small. This periodicity, moreover, is proved to be regular. Prof. Schwabe, of Dessau, discovered that, instead of being uniform in number and intensity from year to year, spots increase and decline at definite rates for a term of years. As a result of 9,000 observations, during which he discovered 4,700 groups, he traced three complete oscillations from maximum to minimum, which he estimated to take place in about ten years. Prof. Wolf, of Zurich, went into an exhaustive history of the subject, and by collating a vast number of observations and records from 1750 to 1860, he verified Schwabe's general results, but showed that the period of oscillation is about eleven years. His data, scattered through a course of 140 years, comprehended observations in the seventeenth century made on 2,113 days; in the eighteenth century, on 5,500 days; and in the nineteenth century, on 14,860, or a total of 22,463 days. On this broad basis of observation, made with no reference to any hypothesis of variation, it is established that the solar energy changes in intensity by a regular law of rise and fall from a maximum to a minimum of effect; and that the maximum, or greatest activity, coincides with the period of violent perturbation when there is the greatest number of eruptions of heated matter from below, and the most conspicuous display of sun-spots and prominences; while at the minimum periods these manifestations are greatly reduced, or almost entirely wanting.

It is now an admitted fact of science that the earth is dependent upon the sun for the chief portion of the energy by which terrestrial effects are produced. With the exception of the ebb and flow of the tides, all the forms of earthly power are recognized as having, directly or indirectly, a solar origin. Wind-power, water-power, steam-power, the activities of organic growth, all animal energy, and the great phenomena of changes in the crust of the globe, due to the circulation of waters through the circulation of atmospheric agency, are caused by the forces of solar radiation. But if the solar energy is variable, the question naturally arises, "Is that variation manifested in terrestrial effects, and, if so, in what manner, and to what extent?" The subject is vast and new, but the indomitable energy of modern scientific inquiry has rapidly accumulated evidence which answers the first question in the affirmative, and gives instructive replies to the others. The sun-spots, for thousand of years unknown, and for centuries after they were known regarded as mere matters of curious and idle speculation, are now linked indissolubly to the whole scheme of activity which we observe upon earth, and of which we are ourselves a part. Even the famines by which nations are periodically desolated seem to be connected with this intermittence of solar energy. The evidence upon the subject has been summed up in an able and impressive paper contributed by Messrs. Lockyer and Hunter to *The Nineteenth Century*, and which will be found in full in No. VIII. of *The Popular Science Supplement*. We can here do little more than indicate the remarkable connections that have been disclosed between the variations of solar activity and resulting terrestrial phenomena.

1. The first coincidence was in the field of terrestrial magnetism. "A freely-suspended magnet, although it points in one direction, is nevertheless within small limits, always in motion. Certain of these motions depend, as is well known, upon the hour of the day; but the magnet is also liable to irregular, abrupt fluctuations, which cannot be connected with the diurnal oscillations. While Hofarth Schwabe was engaged in delineating the sun-spots, Sir Edward Sabine was conducting a series of observations with regard to these spasmodic affections of the needle, and he found that such fluctuations are most frequent in years of high sun-spot activity." Nearly a hundred years ago, Van Swinden had suggested a periodicity in these irregular magnetic movements. Gauss, Arago, Lamont, and Gautier, pursued the research, and established the existence of a cycle of magnetic variation having an eleven year period, the maxima and minima agreeing with the maxima and minima of sun-spot activity. Schiaparelli and Broun have confirmed these results, and the latter observer concludes that, while the sun-spot activity is not an exact measure of magnetic action, "each is a distinct result due to the same cause." This disturbance is so great that, in years of maximum sun-spots, the working of the telegraph has been powerfully interfered with.

2. Connected with these effects there have been observed corresponding disturbances of electrical activity. A magnetic storm never rages without various accompanying signs of electrical excitement. These are seen in auroral displays that in their varying intensities conform to the magnetic cycles. Prof. Loomis, of Yale College, after a critical study of the subject,

"concluded that the auroras observed in Europe and America exhibit a true periodicity closely following the magnetic periods, but not perfectly identical with them;" and Mr. Charles V. Walker, telegraphic superintendent holds as an established fact that "earth currents, disturbed magnetometers, and aurora, are parts of the same phenomenon."

3. There is evidence of thermometric variations, or fluctuations of temperature, in periods coinciding with the sun-spot cycles. The observations in this case are, however, much complicated and obscured by the agency of the atmosphere, which acts as a screen upon the earth's surface, disturbing the radiations that would affect our thermometers. But a large number of observers, among whom are Baxendell, Blandford, Stewart, Roscoe, Piazzi Smythe, Stone and Koppen, have accumulated numerous observations both in the temperate zones and in the tropics, showing that "the calorific intensity of the sun's rays is subject to periodical changes, the maxima and minima of which correspond respectively with those of sun-spot frequency."

4. The wind-disturbances of the earth's atmosphere follow the same law; there being a coincidence between the frequency of cyclones and sun-spots. Observations on other sides of the world, and in the tropics where the wind disturbances are most violent, lead to the conclusion, as stated by Mr. Meldrum, that "the whole question of cyclones is a question of solar activity; and that, if we write down in one column the number of cyclones in any given year, there will be a strict relation between them—many sun-spots, many hurricanes; few sun-spots, few hurricanes."

5. Confirmatory evidence of this is found in the records of shipping-disasters. From the returns of marine casualties posted on Lloyd's loss book it was found that they disclose "a cycle closely corresponding with the sun-spot period. The percentage of casualties on the registered vessels of the United Kingdom (Great Britain) was 17½ per cent. greater during the maximum two years in the common cycle than during the minimum two years."

6. It has been further shown by the observations of Baxendell, Meldrum, Rawson, Jelinck, Wex, Dawson, Hennessey, Broun, and Brockelsby, that there is a fluctuation in the fall of rain in which the same law may be traced; that is, "a connection between the variations of the sun-spot area and the annual rainfall; the rainfall rising above the mean when the sun-spot area is in excess, and falling below the mean when in periods of small sun-spots." The monsoons are the great sources of rain-supply at Madras, in India. The rainfall cycle has been traced out in that country, and the deficiency and excess of rain connected with the great solar periodicities. The writers whom we are following say, for example, that the "water-supply brought to Madras by the southern monsoon is 26½ per cent. greater in ordinary years than in the years of minimum sun-spots." And, again, "there is a rain-cycle of eleven years at Madras which coincides with the cycle of sun-spots; the periods of maxima and minima in these two cycles disclosing a remarkable coincidence."

7. The variation in the rainfall of India involves the food-supply of that country, and is a question of famine and starvation. Observations on the variations of water-supply, in India, of course go no further back than the introduction of rain-gauges. Commencing the inquiry in the year 1810, Messrs. Lockyer and Hunter say: "The years of famine in Madras since that date have been 1811, 1824, 1833, 1854, 1866 and 1877. These famines were caused by deficient rainfall in the preceding years, namely, 1810, 1823, 1832, 1853, 1865, and 1876. Now, five out of these six years of drought fell within the three years' group of minimum rainfall and sun-spots (shown in the foregoing tables) the remaining drought (1853—'55) extended over a year immediately preceding the minimum group, and two years within that group; the famine itself resulting within the minimum group. Three of the six years of drought fell exactly in years of minimum sun-spots; one fell in the year preceding a year of minimum sun-spots; one fell in the second year preceding the a year of minimum sun-spots the remaining drought, 1853—'55, fell in the first, second and third years preceding a year of minimum sun-spots. . . . No famine in Madras has been recorded from 1810 to 1877 caused by a drought lying entirely outside the minimum group of sun-spots and rainfall."

We have here been able only to hint at the points made in the paper referred to. The case is strong, in fact much of it demonstrative, yet it is, of course, most incomplete. Though important practical conclusions have been reached, the investigation is in its crude, preliminary stage, where the truth is caught vaguely and by glimpses rather than seen clearly and by a steady gaze. Yet it is a magnificent research, with already-assured results and a splendid promise. We commend the subject to the consideration of those who hold that science, to be genuine, must have become exact, certain and perfect.—*Popular Science Monthly.*

THE METEORS OF OCTOBER 1-20, 1877.

W. F. DENNING, F. R. A. S.

Here in England the weather was much clearer than usual during the month of October. Between the 1st and 20th, I made a series of observations of shooting-stars, and succeeded in noting 522 of them during the 43½ hours I was enabled to look at the sky. In the mornings 338 were seen in 22¼ hours, and in the evenings 184 were seen in 21¼ hours. Thus the rate of frequency in the mornings greatly exceeded that recorded in the evenings, the calculated horary numbers for one observer (after making certain allowances for time spent in registering the paths) 20.3 being and 10.1 respectively, and for the whole of the night, 15.0. This is rather in excess of the usual figures, and the horary number a. m. as compared with that p. m is also in excess, and readily accounted for by the fact that the chief October shower called the *Orionids* is not favorably visible until after midnight.

Of the total number (522) seen, I carefully registered the apparent paths and other details of 429, their estimated magnitudes being as follows:—

>1st,	10	=3rd,	100
=1st,	22	=4th,	144
=2nd,	83	5th and below,	70

In the early part of the month, I looked toward the northeast sky, and after the 7th either towards the northeast or southeast. My observations prove that meteors were unusually abundant between Oct. 1-20, and I calcuculate that during the twenty days over which they extended, no less than 57,600 shooting-stars brighter than or as bright as 5th magnitude stars entered the earth's atmosphere (night and day, and both hemispheres included) Large as this number appears, it will be readily conceded that it closely approximates the truth. I have already mentioned that the horary number was 15 for the sphere of vision of one observer. Now, one pair of eyes certainly cannot command more than one quarter of the visible heavens, therefore we must adopt 60 as the hourly rate for the *whole* of the visible sky.—Doubling this to include the invisible hemisphere, we have 120 per hour; multiplying this by the number of hours in a day, we get 2880 as the diurnal rate, and finally by the 20 days, through which my watches endured, we have for our product 57,600.

These, however, merely represent the number clearly visible to the eye on a cloudless starlit night. The number *invisible* must have been vast indeed, and beyond all conception. There are probably hundreds of thousands of these minute planetary stones falling into our atmosphere every day, and too small to be discerned with the unaided eye. It must not be imagined however that the horary number of visible shooting-stars, as I observed them this October, is maintained during the whole year. It is excessive, for the spring months are usually less prolific than the autumnal months.

From my own observation of 2081 meteors during the last five months (July-Nov.), in $149\frac{3}{4}$ hours and a half watching (about equally divided between a. m. and p. m.), the hourly number was 13.3 and from this computation I have excluded the *Perseids* (385), which is such a numerous system that to include it in any calculation of the average hourly numbers percepceptible on ordinary nights of the year would be manifestly unfair, though it is equally certain that it cannot be excluded from any investigations as to the annual or monthly number of visible shooting-stars. Excluding this rich shower, however, for the present, and taking 13.3 as the horary rate of the last five months, we may easily calculate that if this is maintained during the year, we have annually more than 930,000 meteors entering our atmosphere, at least equal to 5th magnitude stars.

If we include the great *Perseid* system of August, the number would be much greater (in fact 1.163,330), for on August 10th last alone, I calculate that fully 10,000 visible fragments of this single shower fell towards the earth. Such facts amply prove the enormous numbers of these bodies that actually exist in space, and show what a vast, rich field there is here for observation and investigation. There are not only great numbers of individual shooting stars, but also great numbers of systems to which they belong. My October observations alone were sufficient to clearly prove the radiant points of 47 such systems, and about twenty others were less certainly indicated, and it must be remembered that nearly all my observations were directed towards the N. W. and N. E. sky, so that many showers from the S. and S. W. altogether escaped me.

On very reasonable grounds it may be accepted that at least 100 separate and distinct meteor systems were actually in play during the first 20 days in October! Chief of them all was the well known shower of *Orionids* from which I saw about 57 meteors between the 14th and 19th in the morning sky, and I observed many other well marked and tolerably active showers of which the most important apparently are noted in the following table:—

CHIEF METEOR SHOWERS FROM OCTOBER 1-20, 1877.

No.	Radiant point. R. A. °	Dec. N. °	No. of Meteors observed	Notes.
1.	92	15	57	The *Orionids*.
2.	105	50	15	A new shower in the Lynx.
3.	133	79	22	From Comet II, 1825. Radiant 134°+77 Oct. 7, (A. S. Herschel).
4.	225	52	10	A new shower chiefly Oct. 2.
5.	133	21	18	In Cancer, seen before sunrise.
6.	103	12	22	Active showers seen also in Sept. and November.
7.	115	29	13	The *Gemellids* seen also in Nov.
8.	84	55	18	The *Auriqids* " " Sept.
9.	108	38	16	A marked shower N. of Alpha Geminorum.
10.	310	77	17	An active shower, chiefly Oct. 2-5.

No. 2 in this table has been continued during the present month of Nov., and altogether I have 37 meteors from it. It is extremely probable that this well-marked radiant has only come actively into play during the last two or three years, and it will be important to re-observe it in future years. Prof. Herschel recently said that "Great interest is attached to accurate observations of the course of meteors, for the determination of a meteor orbit ranks in Astronomy with the discovery of a planet." This ought to encourage observation among those who have the opportunity and the desire. No instruments are required to be employed, but the work is, it is true, none the less tedious and difficult on that account. Night after night, month after month, year after year, the sky must be watched, and every shooting-star recorded as it falls! The work is one in which much patience and effort are required. To stand watching the sky 3 or 4 hours on a cold winter's night with perhaps meagre results, must often prove a wearisome, monotonous undertaking, yet it is astonishing how soon we may become habituated to such work, and lose the impatient feeling at first experienced. I remember that, about eighteen months ago, when I began systematically to observe shoot-stars, a watch of two hours required something of an effort to sustain it, whereas, now I continue at work for 5, 7 or ten hours at a time and it is always a pleasant occupation. On a night when meteors are numerous, there is quite an enjoyable excitement, and it is suprising that so few astronomers engage in this special work. Verily, herein the harvest is great and the laborers are few. Though much has already been gathered, we stand as yet only on the outskirts of the rich field of discovery, and I would earnestly invite the members of your society to take some share in the work. Mr. Sawyer, your Secretary, who is himself getting together many useful facts in this department will, I know, be happy to lend a helping hand and give such directions as will ensure valuable and honorable results.—*Science Observer.*

BRISTOL, ENGLAND, NOV. 15, 1867.

HOW THE EARTH APPEARS FROM THE OTHER PLANETS.

"How many eyes are watching us?" is an instinctive thought as one steps out under the glittering dome at night.

It is rather humiliating to learn from astronomers that we are visible only to the Moon, Mercury, Mars and Venus, out of all those myriad lights.

At certain favorable times Jupiter might see us with the aid of a telescope, but it would be only as a small black spot slowly crossing the sun's face.

We are invisible to Saturn. Even if, by the aid of powerful telescopes they could see us, they could not decide whether we were a distinct or seperate ball or attached to the sun.

An imaginary view from Saturn is supposed to depict the scene at midnight, at thirty degrees latitude. The sun has illuminated the beautiful rings, casting a brighter glow over the faint yellowish tint of the orb. The equatorial belt of a creamy white color, the cinnamon-colored belts on either side, and the faint blue of the polar regions, shine more vividly in the reflected light. The satellites sparkling in the distance heighten the grandeur of the scene.

We receive but very faint light from Saturn, as we are 746 times smaller than that planet, and its mean distance from us, according to Proctor, is over 91,000,000 miles.

Uranus can never see us at all, as it is 1,753,000,000 miles from the sun.

Neptune, the most remote of the planets in the solar system, is about, 2,700,000,000 miles from the sun. As we only discovered it about thirty years ago, it need not disturb us to think that the Neptuneites will never know of our existence.

Before inquiring how we look from the planets, let us first learn a little about them, beginning with Mercury, as it is nearest to the sun. The Greeks called it "glittering," on occount of the occasional intensity of its light. An old English writer, Goad, in 1686, humorously calls this planet "a squinting lackey of the sun, who seldom shows his head in these parts, as if he were in debt." From its extreme mobility, chemists adopted this planet as the symbol for quicksilver.

It is supposed that Mercury has mountains higher than our Himalayas, and volcanoes in a state of activity. The planet must be very dense in character. If its materials were similar to those of our earth they would melt in a short time, on account of the proximity of the planet to the sun. The temperature in Mercury is supposed to be seven times hotter than our Torrid Zone. Therefore, if it is inhabited it must be by people very differently constituted from ourselves.

Fontenelle's idea of Mercury and its inhabitants is so very curious and interesting as to be worth quoting. It will easily be seen that his imagination is a powerful one. He says: "The heat to which they are accustomed is so great that the climate of Central Africa would freeze them through. It must be taken for granted that our iron, silver nnd gold would melt in their world, and only appear as a liquid like water. The dwellers in Mercury must be so vivacious as to be mad in our meaning of the term. I believe that they have no more memory than most negroes, that they have not the faculty of thought, that they only act by fits and starts, and that in Mercury Bedlam is the universe."

If these singular people would enjoy seeing us, the best time for them would be when we are on a right line with their planet and the sun. Our illuminated side is then turned toward them. By climbing the steep crags shown in the view (which Schroter says are ten miles high), and looking off into the sky they would see our globe as a magnificent and stately star, moving from west to east, as shown in the figure. Through a good telescope they might see dusky patches here and there, defining the outlines of our continents. Light green tracts would show our seas and oceans. They could see our polar regions white with snow. It is probable, however, that only their Ross' telescope would show these markings.

Venus is the only planet mentioned by Homer. He speaks of it as "beautiful." It was called "Sukra" or "the brilliant," by the Indians. It is often called the "Shepherd's Star," Hesper or the "evening star," and Lucifer, the "morning star." Venus is so bright that it may often be seen at midday with the naked eye. It is supposed there are mountains also on this planet. Halley, the great English astronomer, was the first to announce the fact that the passage of Venus across the sun gave us the means of obtaining the sun's exact distance from the earth.

It is generally admitted that this planet has an atmosphere much like ours. The author of the "Harmonies of Nature," speaking of Venus and its inhabitants, says: "Venus must have mountain peaks five or six times higher than Teneriffe, their sides bright with flowers and birds of brilliant plumage.

"Its inhabitants about the same size as ourselves, since they dwell in a planet of the same diameter, but in a more favored celestial zone, must devote all their time to love."

Could the people of Venus spare time enough from such an agreeable occupation to study their skies, when their planet is nearest to our earth, they would be repaid by a magnificent sight. Our globe would appear to them as a brilliant star, tinged a delicate blue, and larger than any in their sky. With suitable telescopes they would have much the same view of our earth as from Mercury, except that the configurations would be more distinctly marked. The author we have just quoted, in speaking of the brilliancy of the earth, as seen from Venus, says: "Though the long nights in Venus have no moons to light them, Mercury, by reason of its brilliancy and close vicinity, and the earth, by reason of its size, must be more than equal to two moons.

The moon never leaves our globe; therefore it is called our satellite. Though to us it appears larger than the stars, it is really smaller than any of them. Its seeming size is on account of its nearness to the earth, it being distant from us only about 238,000 miles.

The surface of the moon is covered with black spots, which can be seen with the naked eye. Through the telescope it can be seen that they are mountains and extinct volcanoes. Astronomers have calculated that these mountains are higher than any on our earth.

The moon has no atmosphere, according to Sir John Herschel and other careful and accurate observers. If it had we would know it during the occulations of stars and eclipses of the sun. The moon's climate must therefore be very strange, passing suddenly from a heat equal to our torrid zine, to cold greater than the Esquimaux feels. As there is no air, it seems impossible that human beings like ourselves can exist on the moon. There is no sign of vegetation or anything which would indicate a change of seasons. If there were any one on the moon to see it, the earth would appear to them as a magnificent ball. The planets and sun would move behind it in brilliant succession.

The earth has phases like the moon; when it is at its full, the scene is grandest. The basins of our seas and oceans, the contour of our continents, the north and south poles wearing their snowy caps—all these could clearly be seen shining through a vaporous halo. With the aid of a very powerful glass, the avenues of New York and the big trees of California might be seen.

The planet Mars is our next door neighbor, and much resembles us in "atmospheric phenomena and polar cold." To the naked eye it is not very brilliant. Judging by its reddish hue, it is surrounded by a dense atmosphere. We know this because the stars which it passes are hidden before they are eclipsed by the globe of Mars itself.

The name of Mars in Hebrew signifies "ignited;" with the Greeks Mars meant "incandescent;" the Indians called it "Anagraka," which means "burning coal," and the "red body."

Henri de Parkville, in his book, "An Inhabitant of the Planet Mars," gives us a most entertaining account of the supposed discovery of one of these creatures in an ærolite which fell and was found in America. In the portrait of the gentleman, his nose begins at the top of his head and extends down to his mouth, looking much like the short trunk of an elephant. Our readers must make allowance, however, for a French imagination.

Our globe appears to Mars but as a bright star. The earth is nearest to Mars when between it and the sun, but at that time its dark side is turned toward Mars, and of course it is not visible to that planet.

It is therefore only visible to Mars when it is partly illuminated by the sun. Even then it is bright enough to be seen in the daytime. Our earth appears as the morning and evening star to this planet.—*Christian Weekly.*

MEDICINE AND HYGIENE.

HOW TO USE STIMULANTS.

The British Medical Journal of November 10th contains a paper "On the Medical Injunction of Stimulants in Disease and Health." by Dr. Dyce Duckworth, F. R. C. P,, whose eminence as a physician will commend his words to the faculty, while the clear common sense of his inferences will be found a sufficient recommendation of them to the lay readers of the *Times.* Dr. Duckworth agrees that the reproach cast upon England for its notorious drunkenness is utterly grievous. The question, he says, is one for the the clergy and the doctors. When the doctors agree and lay down principles to guide the clergy the two professions will be able to lay an irresistible case before Parliament. It is discreditable to the profession, he thinks, that they should be divided, not in opinion, but about facts. There is no middle course: stimulants are all right if rightly used, or all wrong if used at all or in any degree. Dr. Duckworth then gives what he holds and sees to be the true and legitimate position of thoughtful medical men in respect to the use of stimulants in disease. He groups the diseases in whose treatment alcohol is and is not of use, and concludes that there is no routine in the matter of employing stimulants. "We put alcohol, with its congeners, into our therapeutic armamentarium; it is to hand when wanted, just as are quinine, calomel, the lancet or the cupping glass. We cannot do without it or any of these things, but we employ them or not, as our bedside knowledge indicates."

"But is alcohol or wine food? Some physiologists tell us no. I do not believe them. I am fully satisfied of the nutrient powers of wine and alcohol alone, under some conditions, or more especially in conjunction with other pabula." Stimulants, Dr. Duckworth continues, are not necessary to healthy and well fed people, leading what may be termed normal lives. To them they are a luxury, and not necessarily pernicious. But how many people persistently lead normal lives? He is not prepared to say that a little good beer is not a very valuable addition to the often scant fare and coarse food of working people, or that it may not fairly be taken to counteract, as it will, the many sources of depression to which such people are inevitably exposed in Great Britain. If they cannot get good beer, then the Legislature is at fault. Medical men may fairly tell the healthy, robust, well-fed and well-housed to give up stimulants if they fully maintain their health without them. Total abstainers are generally large eaters, and the ultimate textural effects of excess in eating or drinking, if any, may not be very dissimilar. "I think it is proved," says Dr. Duckworth, "that the addition of a little alcoholic food to a meal secures a more moderate ingestion of solids, and where it agrees, which it does not always, promotes a more satisfactory digestion of them. But a large number of persons suffering chiefly from dyspepsia or insomnia are better without stimulants of any kind. A "daily allowance" of alcohol is manifestly wrong; more to-day and less to-morrow may be needed or extinctively called for. "The rational individual must find out for himself what the special needs of his system are; and where a right-minded Christian individual is in earnest in such a matter, and has a proper control over his appetite, he is not likely to go far wrong in the matter of stimulants."

Medical men should urge teetotalism upon the nervous class of drunkards, persons who are careless and self-indulgent, or who by their lives or calling are much in the way of drink. Stimulants should always be taken at meal times, and only then. "I am confident," Dr. Duckworth says, "that as a body our profession is unanimous in condemning the modern American habit of taking odd glasses of stimulant at all hours, and laments the grievous multiplication of the means of gratifying this mischievous custom, for truly the conduct of the masses of young business men in our cities and large towns, in this respect is becoming disgraceful, and the practice is fast gathering in other circles and communities. Our countrymen of these classes have no excuse for this, for they are well-fed and they have liquors with their meals in addition to their hourly drams, while Americans, who are notoriously the worst dieticians in the civilized world, are water-drinkers at meal-times."?

No serious results, in Dr. Duckworth's opinion, follow the sudden cutting off of stimulants from hard drinkers or delirium tremens patients.—As to teetotal societies, he says:

"I believe that a mission against the drinking habits of all classes and communities, conducted upon the principles of total abstinence, is a hopeless one to embark upon. It is simply to fight the air. Little can, in the nature of thing, come of it. A crusade against our greivously prevalent intemperance, * * * conducted on principles of true moderation and sobriety, is a very different matter. * * * I flatly refuse to believe that the broad stream of common sense and legitimate freedom in this, or any other like matter, has flowed for centuries in a wrong channel, and that we alone in our day are called upon not only to divert but to dam it up for all future time."

Dr. Duckworth, however, does not decry but applauds "the noble example of total abstention from strong drink, set by the clergy and others in conspicuous positions." "We as a body," he says, "are at all events unable to resist the evidence they bear to the effect that their principles alone in many cases enable them to reclaim drunkards and achieve results that would otherwise be impossible.

CURARE IN HYDROPHOBIA.

John Moss, F. C. S., gave in the *Pharmaceutical Journal* of last month, a complete summary of the history, description and chemical composition of Curare, now again proposed in England as a remedy for hydrophobia.

In regard to the administration of the drug, he says:

The properties of curare preclude its medicinal use in any other form than that of a solution for hypodermic injection. For such a solution to be ready for use at all times, certain characteristics are essential, or at least highly desirable. It must be of convenient strength, so that the dose fixed upon may bear a simple relation to the number of minims, yet not so strong that the injection of a quantity slightly in excess of what was intended may be of too great importance, and not so diluted that the maximum dose is inconveniently large. The solution should produce as little pain as possible when injected; having regard to the fact that rabies patients have an intensified dread of pain, this characteristic is perhaps more important in the particular solution now under consideration than in any other. The solution should not only be at all times prepared of the strength that it professes to be, but should keep well, and remain of that strength. To prepare a uniform solution of a drug so deadly and variable as curare, one should always have recourse to the same parcel, of which the strength has been proved. Curarine or one of its salts might be used, but independently of the grave risks incurred in preparing them, we are as yet without trustworthy data upon which to frame a formula.

The keeping power of a solution will depend in a great measure on the menstruum. Water would produce a solution giving the minimum of pain when injected, and Taylor's statement that Bernard preserved curare in solution of water for two years without any loss of its power is confirmed by the experience of Dr. Lauder Brunton, who informs me that he has kept a very weak solution (1 in 1000) for the same period without change. I have prepared solutions of curare in the following menstrua, viz., water, water with 0.2 per cent. of salicylic acid, diluted spirit of wine (I to 3). The last forms by far the best looking solution and is also the best solvent. It dissolves 85.2 per cent. of curare when left in contact with it for twenty-four hours and filtered; the dried residue hardly imparts any tinge to water. Water dissolves 83 per cent. and diluted spirit 79 per cent. of curare, and the dried residue in each case gives a decided tinge to water; both solutions are iridescent on the surface and at the side when examined in a glass vessel, and commence to deposit soon after being filtered. The glycerine solution deposits to a much smaller extent.

It appears, however, from observations kindly communicated to me by Dr. Ashburton Thompson, that even so weak a solution of glycerine as that indicated above, viz., 25 per cent. is productive of great pain when injected; and seeing that the aqueous solution keeps very well, I would propose the following formula as best meeting the requirements of the case:—

HYPODERMIC INJECTION OF CURARE.

Curare..gr. j.

Water...min.xij.

Dissolve; let the solution stand forty-eight hours and filter.

Using this solution two-thirds, a half, third, or quarter of a grain may be given in a whole number of minims. Of the other strengths likely to suggest themselves, viz., one in ten and one in fifteen, the first would only allow of a tenth and a half a grain; and the second, of a fifteenth, a third, and two-thirds of a grain being given in the same way. The accounts of the use of curare seem to indicate that the dose is from a quarter to a half grain.

CAUTION.—Curare requires to be handled with the utmost care. It should not be allowed to come into contact with a fresh cut or a scratch. Two good rules would be, never to powder it in dry condition and never to touch it with naked fingers.—*Druggists Circular.*

TARTAR ON TEETH.

BY A. H. TREGO, D. D. S.

Dentist are continually asked: "What is tartar, and why does it collect on teeth?" Practically, two words answer the two questions: "Indigestion" and "carelessness."

Commercially, tartar is an *acid concrete salt*, produced by fermentation of wine, and is found incrusted on the inside of old wine casks.

"Tartar" on teeth consists of *salivary mucus, animal matter and phosphate of lime.* ("Brown rust," "Caries" and erosions of the enamel are quite different from tartar.)

Tartar is more prevalent in the mouths of "dyspeptics" and in those of persons of "good constitution" who eat rapidly and leave the stomach to finish what the teeth and mastication should have performed. The stomach may not be considered "disordered," but it is made torpid by unmasticated food being forced into it thereby causing "fermentation" instead of allowing natural digestion. (Dr. Abernathy said that "nine tenths of the ills of humanity arise from stuffing and fretting")

The acidulated gas produced by the process of fermentation, rises from the stomach to the mouth; and having an affinity for the saliva and particles of food, a deposit of tartar is the inevitable result. Tartar does not decay the teeth, but inflames, devitalizes and destroys the gums and membranes of the sockets, and thereby loosens the teeth. Once started, it accumulates rapidly, and many persons are ignorant of its presence until great injury is done to the teeth, and surrounding parts. The worst thing to do, however, is to conclude that teeth thus affected, are not worth saving. Reconstructed natural teeth are greatly superior to the best of artificial dentures.

Persons who have lived to the age of maturity in the East, ask "why does tartar accumulate more rapidly in the West?" (A noticeable fact.) Without having made a careful chemical analysis, I have no hesitation in declaring it to be attributable to the superabundance of alkali in the western water. This alkali has a powerful affinity for the acids and gases of the mouth and stomach; and by immediate contact they immediately neutralize each other and form a sediment that unites with the mucus and foreign substances, and produce the concretion.

No chemical preparation will remove tartar without first destroying the teeth. The only successful remedy, is the scaler in the hands of operators who are willing to devote skill and patience to an apparently trifling operation. The most practical preventative, is a reliable dissolvent wash and daily use of good brushes.

N. B.—Never use dentifrices containing soap, charcoal, orris root, alkali, acid or froth.

ARSENICAL ANTIDOTES.—From some late experiments Rouyer has found that although the freshly precipitated sesquihydrate of iron is an antidote for arsenious acid, it has no effect in counteracting the action of sodic arseniate or potassic arsenite (Fowler's solution), but that a mixture of a solution of the sesquichloride of iron and the oxide of magnesium will counteract the effect of these salts as well as the arsenious acid itself, and hence this mixture is always preferable to the hydrate in cases of arsenic poisoning. The officinal solution of the sesquichloride of iron should be first administered, and fifteen minutes afterward the magnesia oxide, given in the proportion of four grammes of the latter to one hundred cub. cent. of the former. In one hour after the administration of the antidote a cathartic should be given. The ingestion of acid drinks and lemonade should be avoided during the entire treatment, since the compounds formed by the union are soluble in acids.—*Rep. de Pharm.*

Vance's Cream for Chilblains.—Ointment of mercuric nitrate, 1 ounce; Camphor, 1 drachm; Oil of turpentine, 2 drachms; Oil of olives, 4 drachms. Mix well. To be applied with gentle frictions before the chilblains break.

Almond Powder for the Hands.—Almonds blanched and powdered, 1 pound; powdered white Castile soap, 8 ounces; powdered Orris root, 2 ounces; powdered Pumice stone, 4 ounces; oil of bitter almond, 2 drachms.

Lemon Cordial.—Fresh lemon peel, 2 ounces; fresh orange peel, 1 ounce; dry lemon peel, 2 ounces; diluted alcohol, 1 gallon; water and syrup, of each, 6 pints.

SCIENTIFIC MISCELLANY.

TYNDALL ON SPONTANEOUS GENERATION.

Prof. Tyndall delivered the opening lecture of the winter session at the London Institution on December 10. He said that within ten minutes' walk of a little cottage which he has recently built in the Alps, there is a small lake fed by the melted snows of the upper mountains. During the early weeks of summer no trace of life is to be discerned in this water, but invariably toward the end of July or beginning of August swarms of tailed organisms are seen enjoying the sun's warmth along the shallow margins of the lake, and rushing with audible patter into the deeper water at the approach of danger. The origin of this periodic crowd of living things is by no means obvious. For years Dr. Tyndall has never noticed in the lake either an adult frog or the smallest fragment of frog's spawn, so that were he not otherwise informed, he should have found the conclusion of Mathiole a natural one—namely, that tadpoles are generated in lake mud by the vivifying action of the sun. The checks which experience alone can furnish being absent, the spontaneous generation of animals quite as high as the frog in the scale of being was assumed for ages as a fact. For nearly twenty centuries after Aristotle men found no difficulty in believing in cases of spontaneous generation which would now be regarded as monstrous by the most fanatical supporters of the doctrine. Redi, in 1668, by careful experiments, destroyed the belief in the spontaneous generation of maggots in putrid meat. The combat was continued by Vallisneri, Schwammerdam and Reaumur, who succeeded in banishing the notion of spontaneous generation from the scientific minds of their day. As regards the complex organisms they dealt with, the notion was banished forever. But the discovery of the microscope, revealing a world of life formed of individuals so minute—so close, as it were, to the ultimate particles of matter—as to suggest an easy passage from atoms to organisms, revived the dying doctrine. Dr. Tyndall now traced its support by Buffon and Needham, (1748) and the experiments with a contrary tendency of Spallanzani, (1779) Schulze, (1836) Schwann, Helmholtz, Schroeder, and Von Dusch. In 1859 Pouchet, a vigorous and ardent writer, strongly influenced opinion in favor of spontaneous generation. In view of the multitudes of motes required to produce the observed results, he ridiculed the assumption that there are atmospheric germs. If there were, indeed, said he, the number that are mathematically required, the air would be entirely obscured by them. The germ clouds would be much thicker than the rain clouds. But had Pouchet known that the blueness of the ethereal sky is actually due to the suspension of innumerable particles in the air upon which the sun shines, he would hardly have ventured on this line of argument. Pasteur, however, published his classical paper in 1862, and his main position has never been shaken. He has applied the knowledge won from his inquiries to the preservation of wine and beer, to the manufacture of vinegar, and to the staying of the plague which threatened destruction to the silk husbandry in France. Prof. Lister has thanked him in a published letter for having furnished the only principle which would have conducted the antiseptic system in surgery to a successful issue. Our knowledge has been greatly extended by Prof. Cohn, of Breslau. "No putrefaction," he says, "can occur in a nitrogenous substance if its bacteria be destroyed and new ones prevented from entering it." Bacteria are the minute animals, so called from the rod-like appearance of some of them, which are now thought to be at the root of the disease as well as of putrefaction. According to this view, a contagious fever may be defined as a conflict between the person smitten by it and a specific organism which multiplies at his expense, appropriating his air and moisture, disintegrating his tissues, or poisoning him by the decompositions it causes.

Prof. Tyndall proceeded to refer very briefly to his own studies on the subject since 1869, and more in detail to his experiments made this summer on the Bel-Alp, above the Rhone valley, the spot 7,000 feet above the sea being selected for the sake of the purity of the air and its freedom from organisms. In describing an actual experiment he would assume he was accompanied by some eminent and fair-minded member of the medical profession, who entertained views adverse from his, because it was obvious that to an important portion of the medical press of London he had not as yet succeeded in rendering this question clear. Sixty flasks would be filled in the manner described in the lecture, with an infusion of beef, mutton, turnip and cucumber, sterilized by boiling and hermetically sealed. They are transported to the Alps. It is the month of July, and the weather is favorable to putrefaction. At the Bel-Alp fifty-four flasks are counted out with their liquids as clear as filtered drinking water. In six flasks, however, the infusion is found muddy. On examination, it is discovered that every one of these has its fragile end broken off in the transit from London. Air has entered the flasks, and muddiness is the result. Examined with a pocket-lens, or even with a microscope of insufficient power, nothing is seen in the muddy liquid; but regarded with a magnifying power of a thousand diameters, what an astonishing appearance does it present? Leeuwenhoek estimated the population of a single drop of stagnant water at 500,000,000; probably the population of a drop of our turbid infusion would be this ten times multiplied. The field of the microscope is crowded with organisms, some "wobbling" slowly, others shooting rapidly across the microscopic field. They dart hither and thither like a rain of minute projectiles; they pirouette and spin so quickly round that the retention of the retinal impression transforms the little living rod into a twirling reel. And yet the most celebrated naturalists tell us that they are vegetables. Has this multitudinous life been spontaneously generated in these six flasks, or is it the progeny of living germinal matter carried into the flask by the entering air? If the infusions have a self-generative power, how are the sterility and consequent clearness of the fifty-four uninjured flasks to be accounted for? It has been affirmed in support of the theory of heterogeny that the vacuum above the infusion is favorable to the production of organisms, and their absence from tins of preserved meats, fruit and vegetables is accounted for by the hypothesis that fermentation has begun in such tins, that gases have been generated, the pressure of which has stifled the incipient life and stopped its further development. But in well preserved tins, Dr. Tyndall has invariably found, not an outrush of gas, but an inrush of water, if they were perforated under water. He has noticed this in modern tins, and in tins which have been perfectly good for sixty-three years. On the other hand, he has exposed the organisms to pressure of gases without killing them. The fifty-four pellucid flasks declare against the heterogenist. The flasks are next exposed to a warm Alpine sun by day, and at night suspended in a warm kitchen. Four of them have been accidentally broken, but at the end of a month the fifty remaining flasks are found as clear as at the commencement. There is no sign of putrefaction or of life in any of them.

These flasks are divided into two groups of twenty-three and twenty-seven respectively. The question now is whether the admission of air can liberate any generative energy in the infusions. The flasks are carried to a hay-loft and the ends snipped off from the group of twenty-three. The twenty-seven flasks are borne to a ledge 200 feet higher, from which the mountain falls away precipitously to the northeast for about 1,000 feet. A gentle wind blows toward it from the northeast, across the crests and snow fields of the Bernese Oberland. The spot is, therefore, bathed in air which must have been for a good while out of contact with either animal or vegetable life. Standing carefully to the leeward of the flasks, for no dust or particle from their clothes or bodies must be blown to the flasks, the operators first singe the pliers in a spirit lamp to destroy all attached germs or organisms, and then snip off the sealed end of the flask. In this way the twenty-seven flasks are charged with clean, vivifying mountain air. The fifty flasks are placed with their necks open over a kitchen stove in a temperature varying from 50° to 90° Fahrenheit, and in three days twenty-one out of the twenty-three flasks opened in the hay-loft are found to be invaded with organisms. After three weeks' exposure to precisely the same condition, not one of the twenty-seven flasks opened in free air had given way. No germ from the kitchen air had ascended the narrow necks, the flasks being shifted to produce this result. They are still in the Alps, as clear (the speaker doubted not) and as free from life as they were when sent off from London. Is not the conclusion, he asked, imperative that it was not the air, but something in the air, which produced the effects observed in the flasks placed in the hay-loft? What is this something? A sun-beam glinting through a chink in the roof or wall, and traversing the air of the loft, which was in free communication with an open door-way with the outer air, would show this air to be laden with suspended dust particles. Can they have been the origin of the observed life? If so, we are not bound by all antecedent experience to regard these fruitful particles as the germs of the life observed?

Dr. Tyndall proceeded to indicate the test of what he described as one of the principal foundations of heterogeny as promulgated in this country. He would place before his friend and co-inquirer, the candid medical critic before assumed, two liquids which had been kept for six months in a sealed chamber exposed to optically pure air. The one is a mineral solution, containing in proper proportion all the substances which enter into the composition of bacteria; the other is an infusion of turnip. Both liquids are as clear as distilled water, and there is no trace of life in either of them. A mutton chop, over which a little water has been poured to keep its juices from drying up, has lain for three days upon a plate in a warm room. It smells offensively. Placing a drop of the fetid mutton-juice under a microscope, it is found swarming with the bacteria, which live by putrefaction, and without which no putrefaction can occur. With a speck of the swarming liquid, the clear mineral solution and the clear turnip infusion are each inoculated. In twenty-four hours the transparent liquids have become turbid throughout, and instead of being barren as at first, they are teeming with life. The experiment is now varied. Opening the back koor of another closed chamber which has contained for months the pure mineral solution and the pure turnip infusion, into each is dropped a small pinch of laboratory dust. The effect is tardier than when the speck of putrid liquid was employed. In three days, however, after its infection with the dust, the turnip infusion is muddy, and swarming as before with bacteria. But what about the mineral solution, which in the first experiment behaved in a manner undistinguishable from the turnip-juice? At the end of three days, at the end of three weeks, it is innocent of bacterial life. While both liquids are able to feed the bacteria, and to enable them to increase and multiply after they have been once fully developed, only one of the liquids is able to develop the germinal dust of the air into active bacteria. The mineral solution, to take an illustration from higher life, can feed the chick but can not develop the egg. But this is not the inference which has been drawn from experiments with the mineral solution. Seeing its ability to nourish bacteria when once inoculated with the living, active organism, and observing that no bacteria appeared in the solution after long exposure to the air, the inference was drawn that neither bacteria nor their germs existed in the air. Throughout the Germany the ablest literature is infected with this error. The death-point of bacteria is another important subject. The experiments already recorded show that there is a marked difference between the dry germinal matters of the air, and the wet, soft and active bacteria of the putrefying organic liquids. The one can be luxuriantly bred in the saline solution, the others refuse to be born there, while both of them are copiously developed in a sterilized turnip infusion. If we boil our muddy mineral solution, with its swarming bacteria, for five minutes, not one of them escapes destruction in the soft, succulent condition in which they exist in solution. The same is true of the turnip infusion, if it be inoculated with the living bacteria only—the ærial dust being carefully excluded. But the case is entirely different when we inoculate our turnip infusion with the desiccated germinal matter afloat in the air. Dr. Tyndall proceeded to explain the system of killing germs by boiling a liquid repeatedly for a short time. Those which are not killed begin to sprout, and are destroyed at the next boiling, when they are in their most tender, helpless and unprotected condition.—*Nature.*

THE TALKING PHONOGRAPH.

Mr. Thomas A. Edison recently came into this office, placed a little machine upon our desk, turned a crank, and the machine inquired after our health, and asked how we liked the phonograph, informed us that *it* was very well, and bid us a cordial good night. These remarks were not only perfectly audible to ourselves, but to a dozen or more persons gathered around, and they were produced by thè aid of no other mechanism than the simple little contrivance explained and illustrated below.

The principle on which the machine operates we recently explained quite fully in announcing the discovery. There is, first, a mouth piece, A, across the inner orifice of which is a metal diaphragm, and to the centre of this diaphragm is attached a point, also of metal. B is a brass cylinder supported on a shaft which is screw-threaded and turns in a nut for a bearing, so that when the cylinder is caused to revolve by the crank C, it also has a horizontal travel in front of the mouthpiece, A. It will be clear that the point on the metal diaphragm must, therefore, describe a spiral trace over the surface of the cylinder. On the latter is cut a spiral groove of like pitch to that on the shaft, and around the cylinder is attached a strip of tinfoil. When sounds are uttered in the mouthpiece, A, the diaphragm is caused to vibrate and the point thereon is caused to make contacts with the tinfoil at the portion where the latter crosses the spiral groove. Hence, the foil, not being there backed by the solid metal of the cylinder, becomes indented, and these indentations are necessarily an exact record of the sound which produced them.

It might be said at this point the machine has already become a complete phonograph or sound writer, but it yet remains to translate the remarks made. It should be remembered that the Marey and Rosapelly, the Scott, or the Barlow apparatus, which were cently described, proceeded no further than this. Each has its own system of caligraphy, and after it has inscribed its peculiar sinuous lines it is still necessary to decipher them. Perhaps the best device of this kind ever conceived was the preparation of the human ear made by Dr. Clarence A. Blake, of Boston, for Professor Bell, the inventor of the telephone. This was simply the ear from an actual subject, suitably mounted and having attached to its drum a straw, which made traces on a blackened rotating cylinder. The bifference in the traces of the sounds uttered in the ear was very clearly shown. Now there is no doubt that by practice, and the aid of a magnifier, it would be possible to read phonetically Mr. Edson's record of dots and dashes, but he saves us that trouble by literally making it read itself. The distinction is the same as if, instead of perusing a book ourselves, we drop it into a machine, set the latter in motion, and behold! the voice of the author is heard repeating his own composition.

The reading machine is nothing but another diaphragm held in the tube, D, on the opposite side of the machine, a point of metal which is held against the tinfoil on the cylinder by a delicate spring. It makes no difference as to the vibrations produced, whether a nail moves over a file or a file moves over a nail, and in the present instance it is the file or indented foil strip which moves, and the metal point is caused to vibrate as it is affected by the passage of the indentations. The vibrations however, at this point, must be precisely the same as those of the other point which made the indentations, and these vibrations, transmitted to a second membrane, must cause the latter to vibrate similar to the first membrane, and the result is a synthesis of the sounds which, in the beginning, we saw, as it were, analysed.

It is a little singular that the machine pronounces its own name with especial clearness. The crank handle shown in our perspective illustration of the device does not rightly belong to it, and was attached by Mr. Edison in order to facilitate its exhibition to us.

In order that the machine may be able exactly to reproduce given sounds, it is necessary, first, that these sounds should be analyzed into vibrations, and these registered accurately in the manner described; and second that their reproduction should be accomplished in the same period of time in which they were made, for evidently this element of time is an important factor in the quality and nature of the tones. A sound which is composed of a certain number of vibrations per second is an octave above a sound which registers only half that number of vibrations in the same period. Consequently if the cylinder be rotated at a given speed while registering certain tones, it is necessary that it should be turned at precisely that same speed while reproducing them, else the tones will be expressed in entirely different notes of that scale, higher or lower than the normal note as the cylinder is turned faster or slower. To attain this result there must be a way of driving the cylinder, while delivering the sound or speaking, at exactly the same rate as it ran while the sounds were being recorded, and this is perhaps best done by well regulated clockwork. It should be understood that the machine illustrated is but an experimental form, and combines in itself two separate devices—the phonograph or recording aparatus, which produces the indented slip, and the receiving or talking contrivance which reads it. Thus in use the first machine would produce a slip, and this would for example be sent by mail elsewhere, together in all cases with information of the velocity of rotation of the cylinder. The recipient would then set the cylinder of his reading aparatus to rotate at precisely the same speed, and in this way he would hear the tones as they were uttered. Difference in velocity of rotation within moderate limits would by no means render the machine's talking indistinguishable, but it would have the curious effect of possibly converting the high voice of a child into the deep bass voice of a man, or *vice versa.*

No matter how familiar a person may be with machinery and its wonderful performances, or how clear in his mind the principle underlying this strange device may be, it is impossible to listen to the mechanical speech without experiencing the idea that his senses are deceiving him. We have heard other talking machines. The Faber apparatus for example, is a large affair, as big as a parlor organ. It has a key board, rubber larynx and lips and an immense amount of ingenious mechanism which combine to produce something like articulation in a single monotonous organ note. But here is little affair of a few pieces of metal, set up roughly on an iron stand about a foot square, that talks in such a way, that, even if in its present imperfect form many words are not clearly distinguishable, there can be no doubt no that the inflections are those of nothing else than the human voice.

We have already pointed out the startling possibility of the voices of the dead being reheard through this device, and there is no doubt but that its capabilities are fully equal to other results just as astonishing. When it becomes possible, as it doubtles will, to magnify the sound, the voices of such singers as Parepa and Titiens will not die with them, but will remain as long as the metal in which they may be embodied will last. The witness in court will find his own testimony repeated by the machine confronting him on cross examination—the testator will repeat his last will and testament into the machine so that it will be reproduced in a way that will leave no question as to his devising capacity or sanity. It is already possible by ingenious optical contrivances to throw stereoscopic photographs of people on screens in full view of an audience. Add the talking phonograph to counterfeit their voices, and it would be difficult to carry the illusion of actual presence much further.—*Scientific American*, *December 22d.*, 1877.

Mr. Thomas A. Edison, the inventor of the talking phonograph which we recently described, informs us that he has constructed a new and larger machine which not merely speaks with all the clearness which we predicted would be obtained, but loud enough to be audible at a distance of 175 feet. —*Scientific American*, *Jan.* 5, 1878.

LAMP-LIGHTING BY ELECTRICITY.

Such is the progress the science of electricity is making in the hands of its practical exponents, that we have now to record the fact that any number of the street lamps can be dealt with—that is London or any other town can have the whole of its public gas lamps turned on, lighted, and turned off instantaneously, with ease and, so far as at present has been seen, with certainty. The highly ingenious invention by which this is accomplished is due to Mr. St. George Lane Fox, and is on trial at the station of the Gaslight and Coke Company at Fulham, where we recently inspected its practical working. The arrangements by which a revolution in our public lamp-lighting promises to be effected consists, in the first place, in connecting the lamps together by conductors, consisting of insulated metallic wires. By this means an electric current, generated at a station or central point, operates simultaneously upon every lamp through the instrumentality of an apparatus attached to each lamp. The apparatus constitutes the special feature of Mr. Fox's invention. It is difficult without drawings to describe precisely this ingenious piece of mechanism, but broadly it may he stated to consist mainly of a soft iron core, around which is a coil of insulated wire, thus forming an electro magnet. The wire of this electro magnet forms part of the electric circuit by which the lamps are connected, and constitutes in itself a primary coil. Around this primary coil is wound a secondary coil of fine wire of much greater length. We thus have an induction coil and a fixed magnet, which can be magnetized so as to render its poles reversible at pleasure. Above this fixed magnet is a permanent steel magnet, which, however, is moveable, being free to turn on a needle point forming a vertical axis, thus affording it the means of developing a reciprocating horizontal motion when actuated. These magnets are carried in a small metal framing, having a passage through it for the gas to pass to the burner at the top, and being provided with a stop-cock, which is actuated by the reciprocating magnet. The whole of this apparatus is inclosed in an air-tight metallic case, and is only about 2½ inches high, and 2½ inches wide at its greatest width, and is screwed on to the supply-pipe in the lamp, the conductor being carried down the interior of the lamp-post and laid underground, except where an overhead line is admissible.

This apparatus has two functions, one being to turn the gas on and off, and the other to light it at the point of the burner. The former is accomplished by opening and closing the stop-cock by means of what may be called an electric needle-tap, and the latter by the induction coil, the whole, however, being in combination. The plug of this needle-tap is cylindrical, about three-eighths of an inch in diameter, and is carried in a socket which it fits rather loosely. It is made to turn in this socket by the action of the reciprocating magnet, a couple of studs on which are brought into contact with a small pin connected with the plug, and forming, in fact, the handle of the stop-cock. The annular space between the plug and the socket—which is about the one-thousandth part of an inch—is filled with oil, which is retained by capillary attraction between the two surfaces, the joint being thus rendered perfectly gas-tight. The oil of bitter almond is used on account of its non-oxydizable character, and from the power it possesses of resisting the action of very low temperature. Such is the apparatus designed by Mr. Fox, in which it will be seen that a very special feature is the introduction of a fixed core which can be magnetized so as to render its poles reversible at pleasure, and, in conjunction with it, a moveable magnet, the polarity of which, however, is permanent.

We have now described the means whereby this apparatus is rendered active and the method of operating with it as witnessed by us on our visit to the Fulham station. Assuming a group or series of gas-lamps to be connected by a conducting wire, the ends of the wire from this circuit are connected with a switch, which is simply a little piece of mechanism for placing the circuit in communication with, or disconnecting it from the battery. An electric current is first sent through the circuit from an ordinarily powerful telegraph battery. The result is that the soft iron core in each apparatus becomes converted into a temporary magnet, and the permanent reciprocating magnet above it is made to turn upon its axis. In performing a partial revolution the projections upon it engage with the pin or handle of the stop-cock, and, turning that around, open the cock and admit the gas to the burner. The battery is then disconnected from the circuit, and a condenser is charged by means of a Rumkorff coil, and then discharged through the circuit. The result is that an independent electric discharge is induced at the burner of every lamp at the same moment, and the gas is ignited by means of a pair of metallic points, which are connected with the secondary coil, and which deliver the spark. To extinguish the light the wires are reconnected with the battery by the means of a switch, but in such a manner as that a reverse current is obtained. The permanent magnet of each lamp is thus caused to return to its normal position, and in so doing it again acts on the pin of the stop-cock and thus turns off the gas.

This system was introduced by Mr. Fox at the Fulham Station about eight months since, and altogether forty lamps scattered about in various parts of the company's extensive premises have been used to test the principle. About two months ago the number connected up was reduced to twenty-three, in order to enable the company's engineer, Mr. F. McMinn, to make an official trial of the system by direction of the governor and directors of the company. The trial ranged over six weeks and in its results enabled Mr. McMinn to report most favorably upon the merits of the system. For all practical purposes, however, the invention may be said to have had an eight months' trial.—*London Times.*

CAUSES OF EXPLOSIONS IN MINES

Mr. W. Galloway, in *Nature*, has the following seasonable remarks on this subject:

Before the invention of the safety lamp, the only means of guarding against the ignition of firedamp consisted in the employment of an apparatus called the "steel mill." The light obtained by its aid was feeble and uncertain, and Mr. Buddle informs us that explosions were known to have been caused by the sparks emitted by it. When Davy made his brilliant invention in 1815–16, the steel mill was laid aside for ever, and it was then imagined that colliery explosions had almost become phenomena belonging to a past order of things. So confident, indeed, was Davy in the efficacy of his lamp, that he believed it could be safely employed for carrying on work in an explosive atmosphere. But one explosion followed another in an unaccountable manner; and a select committee was appointed in 1855 to inquire into the nature of accidents in mines. In 1850 Mr. Nicholas Wood made a series of experiments, which proved that when a Davy lamp is subjected to an explosive current traveling at the rate of 8 or 9 feet per second, the flame soon passes through the wire gauze. This was corroborated about 1867 by experiments conducted by a committee of the North of England Institute of Mining Engineers. In 1872–73, the writer demonstrated, also by experiment, that when a lamp burning in explosive gas is traversed by a violent sound-wave, such as that produced by a blasting shot, the same result follows, that is, ignition is communicated to the outside atmosphere.

The atmosphere of a part of a mine may become explosive before the men escape, either by the sudden influx of a quantity of firedamp from some natural cavity in which it had existed in a state of tension, or by a partial or total cessation of the ventilating current; and I propose to consider how such an event could produce an explosion, supposing all the men to be provided with safety-lamps. This will happen (1) if the inflammable gas passes over a furnace at the bottom of the upcast; (2) if it is carried against a Davy and Clanny lamp at a greater velocity than 7 feet per second, or if the lamp is traversed by a sound-wave; (3) if a blasting shot is fired directly into it; and lastly, if it reaches a safety-lamp that has been opened by one of the men.

The means that have been provided for guarding against these contingencies are as follows:—(1) Furnaces have to a large extent been replaced by ventilating fans in fiery collieries. (2) Davy and Clanny lamps are still almost universally employed. (3) Shot-firing, having been found to originate many explosions, although probably in a manner not yet understood by most people, is now carried on under certain restrictions which are still insufficient. (4) Much nonsense has been talked and written about miners opening their lamps. The present flimsy pretense for a lock is not a necessity but a cheap convenience; and who is responsible, if, say 100 men are killed through its being opened by one? Is there no responsibility attached to the owners or the legislature for placing the lives of ninety-nine innocent men in danger? I think there is. The influence of changes of weather on the internal condition of mines has been remarked since the remotest times, and for the last fifty or sixty years at least many have asserted that firedamp is more prevalent when the barometer is low than in the opposite case. When vigorous artificial means of ventilation are employed, and ordinary skill practiced in distributing the air the effects of change of weather become much less perceptible. If a large proportion of explosions can be shown to occur simultaneously with, and therefore, presumably, in consequence of, those atmospheric changes that would tend augment the amount of firedamp in the workings, there is a strong argument in favor of the supposition that they are preventible, and cannot therefore be considered as accidents in the true sense of the term. With this object in view, diagrams have been made from time to time by Mr. R. H. Scott and myself, and also by one or two others, showing the connection that exists between the two classes of phenomena, and an examination of these is sufficient to convince unbiased persons that there is a striking coincidence between the explosions and the favorable atmospherical conditions. A general rule was inserted in the Coal Miners' Regulation Act (1872) making it compulsory for mine-owners to place a barometer and thermometer at the entrance of every mine in the coal measures. It has always been difficult, and sometimes impossible, for mining men to give an adequate reason for the extent of great explosions; and more especially when it is known that, immediately beforehand, little or no inflammable gas has been present in the workings. The reports of the Inspectors of mines bear ample testimony to the correctness of this statement. In September, 1844, before the appointment of inspectors of mines, Lyell and Faraday were sent to Haswell Colliery by the Home Secretary to report on an explosion that had just taken place there. I am unable to quote from their official report, but I am firmly convinced that the following sentences taken from their article on the subject in the *Philosophical Magazine*, 1845, is the true key to a solution of the problem as regards both the mode of occurrence and means to be used for the purpose of avoiding great explosions in future. The sentences referred to are these:—" In considering the extent of the fire for the moment of explosion, it is not to be supposed that the firedamp is its only fuel; the coal dust swept by the rush of wind and flame from the floor, roof, and walls of the works, would instantly take fire and burn, if there were oxygen enough in the air to support its combustion; and we found the dust adhering to the face of the pillars, props, and walls in in thè direction of, and on the side towards the explosion increasing gradually to a certain distance as we neared the place of ignition. This deposit was in some parts half an inch, and in others about an inch thick; it adhered together in a friable coked state; when examined with the glass it presented the fused round form of burnt coal dust, and when examined chemically, and compared with the coal itself reduced to powder, was found deprived of the greater portion of bitumen, and in some cases entirely destitute of it." About three years ago M. Vital, Ingenieur des Mines in France, showed that a flame resembling that produced by a blasting shot which blows out the tamping is greatly lengthened in an atmosphere containing a cloud of coaldust; and soon afterwards the writer ascertained that air containing a small portion of firedamp (less than one per cent. by volume) becomes highly inflammable when coal dust is mixed with it. These discoveries complete what Lyell and Faraday began, and show how explosions of any conceivable magnitude may occur in mines containing dry coal dust. A blasting shot or a small local explosion of firedamp, or a naked light exposed when a cloud of coaldust is raised up by a fall of roof in air already containing a little firedamp, is sufficient to initiate them, and when once they are begun, they become self-sustaining. Out of many hundred collieries known to me, there is not, to my knowledge, a single damp one in which a great explosion has happened; while, on the other hand, there is a considerable number of very dry ones in which explosions, causing the deaths of from 12 to 178 men at a time, have occurred.—*Engineering and Mining Journal, Jan. 5th*, 1878.

THE SPRINGS OF SOUTHERN NEVADA.

BY D. A. LYLE, U. S. A.

It is the intention of the writer to merely jot down a few personal recollections of some of the springs visited in the arid region of Southern Nevada, while a member of one of the Wheeler expeditions.

To those who have experienced the pangs of thirst while journeying over the desolate wastes that characterize this section, it will not be surprising that reminiscences of water should linger longest in the memory of the traveler. In fact the procurement of that necessity is a matter of such vital importance that all movements are subordinated and controlled by the answer to the question, "Is there any water there?" Should the reply be in the negative, some other route must be followed, or else a supply of water must be carried along. The springs in this portion of the Great Basin are few, and often far between. Their waters differ much in quantity, temperature and chemical composition. In quantity, the yield varies from a few gallons per day to a never failing supply. As to temperature, the heat of the waters range through cold, cool, tepid and warm to boiling. As regards chemical composition, some are fresh, others alkaline, and still others, sulphurous. In the waters of some springs, a mere trace of saline ingredients are found, while in other cases the salts are present in sufficient quantity to produce saturation.

The first that will be mentioned are Mud Springs, also known as Desert Wells, from the fact that parties passing that way, have dug pits from four to eight feet deep when there, in search of more water. These springs, when visited by the writer, were mere pools of muddy slime, with a slight film of stagnant water overlying the viscous blue marsh. So nauseous were these waters that neither men nor animals could drink them. Enough water, however, was obtained by digging new pits or "wells" near by, to partially alleviate the sufferings of man and beast, which were somewhat intense after marching over thirty miles through the heated sands of the Smoky Valley Desert upon a July day.

These springs—if springs they may be called—were situated at the southern extremity of Smoky Valley, surrounded by a dreary waste of sand and "alkali flats," with here and there a stunted sage bush.

Day break the following morning found the party en route to Silver Peak, the next objective point. Silver Peak, a small mining camp, is located near the west side of Clayton Valley, and at the eastern base of the Red Mountain range. Near this place and along the western border of the salt marsh which forms the major part of the basin are the Thermal Springs. The more important ones are eleven in number. With one exception they are contained in a narrow belt, running almost north and south. This belt is about a half mile in length, its width being but a few rods. Beginning at the southern limit of this line, the first spring we encounter is in a small depression in the general surface. Its waters are slightly saline, but quite palatable, and are the best for use in the vicinity. The temperature of the water is 69° Fahr. Just north of this is found a cluster of springs; the largest and most central one is called Saturn. Their temperatures are 69.5° Fahr. These springs are in close proximity to each other, and flow out upon a level area some twenty acres in extent, covered with a rank growth of coarse salt grass, from whence the water flows into the salt marsh.

Proceeding northward, we next meet with three salt springs arranged in the form of an isosceles triangle, differing widely in temperature and the degrees of their saturation.

These are situated in the edge of the salt marsh, the two forming the base, being in an east and west line, twenty feet apart. The more westerly one has a temperature of 79° Fahr., while the other one in its quiescent state has a temperature of 117.8° Fahr., and at irregular intervals boils and emits steam. The third, forming the apex of the triangle and lying ninety feet north, has a temperature of 116.5° Fahr.

Still further north are two more salt springs, situated also in an east and west line, only four feet apart; the westerly one, as before, having the lowest temperature, being 79° Fahr., while the other has a temperature of 117° Fahr. Another spring, about one-fourth of a mile north of the others, was constantly boiling and emitting steam. A gurgling noise could be heard in several places near the main opening, under the tufaceous crust of calcareous matter deposited by its waters. In approaching this spring the greatest caution had to be exercised to avoid breaking through the crust of tufa which bridged and in part, concealed the seething waters, which could be seen through the many perforations in this treacherous envelope. Every step in advance was carefully treated by striking the tufa with a mining hammer, to see if it would bear the weight of a man. Thus, by slow degrees one or two members of the party succeeded, without accident, in reaching the main opening, which was about five feet in diameter. Regard for personal safety, however, soon overcame scientific curiosity, and the retreat was accomplished by separate routes in the same cautious manner, to avoid getting too much weight upon any one place. The waters were found to be impregnated with soda, lime and borax.

In the immediate vicinity of the hot springs were found numerous concretions, either on the surface or slightly imbedded. These had generally a prolate spheroidal form, although many eccentric shapes were seen. About half a mile out in the salt marsh was a remarkable spring, nearly twenty feet in diameter. The water rose to the height of several inches above the general surface, and was retained by a ring of earth elevated a foot above the terrain and thickly set with *tules*, a kind of rush, whose verdancy contrasted strangely with the sombre gray around, and gave to it the appearance of a miniature oasis. The water was quite clear and nearly fresh; this latter property was probably only apparent from the contrast, after imbibing the more brackish water of the other springs; its interior cylindrical walls extended to a depth of about five feet, below and under which, as far as could be reached by a pole, nothing like earth could be felt. There appeared to be a subterranean lake beneath the salt marsh, of which this spring was the only visible portion. As to its depth we had no means of determining it; the temperature was 69° Fahr. The circumjacent earth was a mere superficial crust, five or six inches thick, which was springy beneath our tread, and breaking through which one sank into the viscous mud. In walking over this area the ground constantly jarred and trembled, thus indicating the elasticity of the indurated envelope. Even on the road near our camp, west of the marsh, when animals traveled over it, a dull, hollow sound was heard, bearing out the hypothesis of the existence of a subterranean cavity. The plain is crossed in two or three places by roads and trails; and should animals get off these, they break through and often become submerged in the mire. At one or two places shallow trenches or vats have been scooped out, and the salt water collecting and evaporating in them leaves the walls and bottoms covered with beautiful crystals of pure salt.

Traveling westward from Silver Peak, a distance of eleven and three-fourth miles, during which the Red Mountain range is crossed, Mountain Spring is reached. This spring bubbles up at the foot of Red Mountain peak. The water is clear, cold and not in the slightest brackish. Its appearance was hailed with joy by men and animals. At last water had been found that would slake instead of increasing thirst. Here, in the short interval of less than ten miles, the physical characteristics of the water supply had radically changed.

On the east side of the Red Mountain range the springs were thermal, brackish, and often nauseating, while on the western slope they were pure, cold and refreshing.

A few miles west of Red Mountain Spring, in a dry ravine, through which the traveler passes to reach Fish Lake Valley, is found Mamie Spring. The water is excellent and plentiful. Its situation is rather unique. In the bottom of a dry wash lies a very large boulder of conglomerate, or more strictly of breccia, transported from some distance, from the under side of which the water of the spring gushes into a little pool or basin it has made for itself. From this basin the water, overflowing, traverses for a few yards the gravelly bed of the wash, when it sinks and is seen no more. The huge boulder that shadows this little basin with its overhanging edge is mainly composed of a very hard arenaceous matrix, in which are seen imbedded many rounded pebbles of various sizes, and also large angular fragments of rock. The most remarkable thing about this spring was the fact that it had only been running about two years, having suddenly sprung into existence, the miners said, since they had been in the vicinity.

Upon the eastern edge of the Amargoza Desert is quite a large area called Ash Meadows; so named from a small species of ash tree growing there. The meadows are covered with good grass and are well watered by numerous warm springs.

The principal spring was about thirty feet in diameter and situated at the foot of a small butte. The water issued from the bottom, through a tufaceous mass of rock.

It was about four or five feet deep, and was cooler than the other springs. The stream of water that flowed out was five inches deep and two feet wide, and clear as crystal. The sides and bottom of this spring were covered with a white, chalky-looking deposit, that gave a milky tinge to the water when stirred up. A few small fish were seen in this spring. Many of the springs in this vicinity contained quicksand.

Southeast of Amargoza is Pah-rimp Desert. About the middle of the upper end of this dreary waste of sand and sage bushes are several little oases bountifully watered with exhaustless springs, some of which are very large, and the confluence of their waters form quite a large creek that flows off towards the southwest, but is soon lost in the sand. Splendid grass abounds all along the banks of this water course. Immediately around the springs a band of southern Pah-Ute Indians is located, and by irrigation succeeds in raising a quantity of corn, squashes and watermelons. Willow trees and wild grapes are indigenous, the latter growing in the greatest abundance.

Mound Springs. By this appellation it is proposed to designate those springs situated upon small mounds rising above the general surface of the country surrounding them. The most prominent mound noticed by the writer was upon the Vegas plains in Southern Nevada; its base was circular and about twenty-five feet in diameter, it was fifteen feet in height and was covered with "*tules*" and coarse grass. Several small sulphur springs oozed from its nearly flat top, and provided moisture for the tangled vegetation.

It appeared as if built up by the partial decay of organic matter and the depositions of these numerous springlets. The soil was tremulous and yielding to the tread, and resembled in that particular the sphagnous bogs of Alaska. The fumes of sulphuretted hydrogen were strongly apparent even at some distance from the mound.

A short distance beyond the mound above mentioned, occurred the Las Vegas Springs, the largest of which was apparently about three feet deep, with white quicksand constantly "boiling up" from the bottom. Quite a large creek issued from it and ran in a southeasterly direction for a mile or more. This spring had been regarded by the Indians and squatters as a rather supernatural one, and among other improbable legends was said to be bottomless. This myth, at least, was exploded when a sixty pound weight tied to a cord was used to sound its depth. This weight sank eighteen feet and three inches through the ever varying quicksands, and then came to rest. Further on ran the other springs, which also poured their waters in the creek flowing from the first one. On the left bank of this creek stood an old *adobe* enclosure, rectangular in shape, built by the Mormons some years before.

Two or three long cottonwood trees shaded the creek near the quadrangle. Here the bed of the stream was broken into a series of little rapids or falls, none exceeding four feet in height, formed by rocks of calcareous tufa.

At the foot of these miniature waterfalls was a quiet pool, about five feet deep and ten feet in diameter, used in former times by the Mormons as a baptismal font. The land along the banks of the creek had been cultivated, and at this time were seen the remains of irrigating ditches, which attest the industry and enterprise of this strange, and to our minds, deluded people. These fields are now overgrown with mesquite and thistles, the latter attract numberless goldfinches, humming birds and bumble bees.

In the springs above enumerated, the reader has a sketch of a few of those in Southern Nevada. The springs of this inhospitable region are so few, that at one time or another, each one becomes, as it were, the polar star of the desert traveler, towards which he turns his face with inflexible determination.—*American Naturalist.*

GROWTH OF MINERALS.

BY G. C. BROADHEAD.

Your paper some time since, also of date 22d inst., contains notices of Mr. Redwin and mineral growth. Although his specimens must be quite interesting forms of crystallization, still I do not see that his proof is conclusive—at least of a growth like unto that of either plants or animals.

Does he observe a mineral start from a root-stock, and gradually increase and expand, both in length and breadth, like plants do when they receive nourishment? Can minerals during their growth (?) receive nourishment like plants and animals, and vivify under the influence? If all these things are proven, then his minerals may be said to grow; and when nourishment is withdrawn, they would lose their brilliancy, die and change their organic (?) structure. Do his minerals do so? If they do not then his theory is not proven. We all know that by exposure, certain minerals oxidize more rapidly than others; but this could not be said to be loss of life, as understood among plants and animals Nevertheless there are certain peculiarly interesting forms of crystallization that rather puzzle us as to how or why they appear so.

Minerals have their own peculiar structure of crystal. Some at times present a fibrous structure, which may be likened to growth.

Why is it that the Millerite occurs in extremely fine hair-like crystals shooting as it were from the base of pearl spar crystals into and through calcite, as they do in specimens in my cabinet? Specimens show it starting forth in divergent lines, and also somewhat fasciculated.

I also have specimens of needle-like crystals of Gœthite radiating from the base of calcite crystals, sometimes penetrating and passing through them. I have them also penetrating quartz crystals. But a most interesting specimen in my collection is of smoky quartz from North Carolina. It is of a deep rich color, yet beautifully transparent. It is about four inches thick, but passing entirely through it is a fascicle of hair-like crystals of rutile, .1¼ inches wide by ¼ inch thick. Other single hair-like crystals traverse it in other directions, but are easily traced throughout. For these I could detect no point of departure as in Gœthite and Millerite. Very pretty specimens are those from Cumberland, Rhode Island, of quartz showing acicular crystals of Hornblende traversing it in various directions, but each seeming independent of the other.

Barytes is often found in Missouri, showing pipe iron ore traversing it; but in this case the iron ore is stalactitic, it being formed first and afterwards surrounded by baryte.

Minerals are often seen occupying drusy cavities—attracted to the sides of the cavity—the points of crystals directed towards a central place. These have evidently crystallized from mineral solutions as can be proven in a chemical laboratory. Loaf sugar can be crystalized, but no organic growth can be detected. I collected at Oronago, Jasper county, many specimens of chert, all showing that they had been blasted out within a few years past by the miners, but at that time this locality was abandoned. Many had small, waxy looking globules adhering to their surface, some attached to the evidently recent fractured rock. Analysis proved them to be carbonate of zinc. This I think is a proof that minerals are forming; that is, being *crystallized now as well as long since.*

I have before me a stalactitic form from a cave in Galena, Kansas, showing a central nucleus of claystone; next to and nearly surrounding it is the white aggregation of small stalactites, about $\frac{3}{4}$ of an inch long and terminating in hollow-rounded points—the deposit of the last drop of solution. Next to this aggregation, and apparently a continuation of and adhering to the stalactitic mass and radiating beyond for a $\frac{1}{2}$ inch to 1 inch, is a collection of numerous minute white hair-like calcite crystals. At one side the stalactites we know have been formed by regular dripping in water holding calcareous matter in solution, and the whole stalactitic mass presents the phenomena of stalactites attached to each with crystals apparently emanating from them. The presence of the crystals can most probably be explained by the cave becoming filled with water containing much calcarious matter, since the period when the stalactite was formed.

Geologists are familiar with the fact that minerals often crystallize around fossils, or some hard substance in turn forming a concretion.—*Mines, Metals, Arts and Railroad Journal.*

ST. LOUIS ACADEMY OF SCIENCES.

The Academy of Sciences held its twenty-second annual session January 7, 1878, at the Polytechnic Hall, with twenty-three members present. In the absence of Prof. C. V. Riley, Dr. Forbes was called to the chair.

Judge N. Holmes, the Corresponding Secretary, submitted a number of letters from various points. Under the call for donations, Judge Terry presented to the Society the original draft of Mr. Ira Stout's air ship. Mr. Stout had promised to be present at the meeting and give the members his views on ærostation, but having received an urgent call from Indianapolis, had been obliged to leave the city. Judge Terry also laid before the Society a fine specimen of septarium formation, found by him at the Hot Springs.

Prof. Riley, who had in the meantime arrived, laid before the body a paper on mite transformations, which was referred to the Publication Committee; also a note on ocean gulls.

Prof. Nipher handed in a report upon the earthquake of November last, together with a chart describing its boundaries, prepared by Prof. Gustavus Heinrichs, of the Iowa weather service. The report showed that the earthquake of November 15 had extended from Julesburg, Col., to La Crosse, Wis., and from Olivet, D. T., to Topeka Kas. The territory disturbed forms an elipsis, the minor axis of which measures over 300 miles from N. N. W. to S. S. E., while the major axis extends from W. S. W. to E. N. E. over 600 miles, and comprises fully 150,000 square miles. The greatest energy of the earthquake was manifested along the Missouri River from Yankton to Sioux City, at 11:30 a. m., and along the Platte River, from Columbus to Omaha, at 11:40. The principal shock reached the eastern, southern and western limits about 11:50. From these data follows a velocity of transmission of fully 600 miles per hour.

Judge Holmes submitted his annual report, showing on the list of exchanges with the Academy 221 foreign publications, and 100 emanating from various societies within the United States.

The Librarian made his report, in which a condition of affairs not altogether creditable to the society was set forth. There were 2,676 volumes and 4,100 pamphlets catalogued, but they were in bad condition generally, and deserved the attention of the Academy.

Dr. Enno Sander, Treasurer, reported expenditures during the year amounting to $668, with receipts falling short of this amount. He took the occasion to refer to dilatory members whose dues were unpaid.

The Board of Curators and Committee on Library submitted brief reports.

President Riley read his annual report, which was a comprehensive and interesting document, setting forth the progress of the society through a period of twenty-two years, the hardships that had been met and overcome, and the obstacles that still stood in the way of the permanent success of the Academy. There were 110 members on the rolls of the Academy, twenty-four of whom had been elected during the past year. In addition to these there were 143 corresponding members.

The Academy then proceeded to the election of officers for the ensuing year. Mr. Pulsifer nominated Dr. George Englemann, and Judge Holmes Prof. Riley. The latter gentleman stated that he had occupied the chair of presiding officer for two years, and believed, under the rules a re-election was not permissible. At all events he would decline. Dr. Engelmann was elected president without opposition, the Recording Secretary casting the vote of the Academy.

The other officers elected were as follows: 1st Vice President, Prof. Riley; 2d Vice President, Silas Bent; Treasurer, Dr. Enno Sander; Corresponding Secretary, Judge Holmes, Recording Secretary, Prof. Nipher; Librarian, Prof. E. M. Crunden; Board of Curators, Dr. G. J. Engelmann, Dr. Hambach, and Mr. Hilder.

Mr. John Goodin was chosen an associate member of the Academy.

METEOROLOGY.

KANSAS WEATHER REPORT, DECEMBER, 1877.

BY PPOF. F. H. SNOW.

STATION—Lawrence, Kansas, corner of Tennessee and Pinckney streets; elevation of barometer and the thermometer 875 feet above the sea level and fourteen feet above the ground; anemometer on the University building, 105 feet above ground.

The month was remarkable for its high temperature and excessive cloudiness.

Mean temperature 44°.43, which is 5°.20 above that of November, and 16°.31 above the December average of the nine preceding years. The next warmest December on our record was in 1875, with mean temperature 39°.35. There were only two days whose mean fell below the freezing point; in December, 1876, there were 24 such days. The highest temperature was 68°, on the 12th; the lowest was 10°, on the 1st: range of temperature, 58° Mean at 7 a. m., 38°.79; at 2 p. m, 51°.22; at 9 p. m., 43°.87.

Rain and melted snow, 2.21 inches, which is 0.36 inches above the December average. Either rain or snow fell on ten days. The entire depth of snow was only half an inch, which fell on the 29th; there were snow flurries on the 5th. There were two thunder showers—on the 16th and 17th. The total rainfall for the year 1877 has been 41.09 inches.

Mean cloudiness, 58.17 per cent. of the sky, the month being 9.21 per cent. cloudier than usual. Number of clear days, 12; (entirely clear, 4); half clear, 5; cloudy, 14 (entirely cloudy, 9). There were six entirely cloudy days in succession. Mean cloudiness at 7 a. m., 64.84 per cent.; at 2 p. m., 59.03 per cent.; at 9 p. m., 50.64 per cent.

Wind—S. W., 33 times, N. W., 24 times; S. E. 11 times; N. E. 9 times; N., 8 times; S. 3 times; E., twice; W., once; calm twice. The entire distance traveled by the wind was 10,683 miles, which gives a mean daily velocity of 34.6 miles, and a mean hourly velocity of 14.36 mile. The highest velocity was 45 miles an hour on the 29th.

Mean height of barometer, 29.191 inches; at 7 a. m., 29.208 in.; at 2 p. m., 29.167 in.; at 9 p. m., 29.196 in.; maximum, 29.575 in., on the 8th; minimum, 28.596 in., on the 4th; monthly range, 0.979 in.

Relative humidity—Mean for the month, 74.4; at 7 a. m., 83.12, at 2 p. m., 62.3; at 9 p. m., 78.8. Greatest 100, on several occasions; least, 30.7 at 2 p. m., on the 2d. There was no fog.

The following is a copy of a portion of the daily record of temperature, direction and velocity of wind, face of sky, humidity and rainfall:

Date.	Temperature. 7 A. M.	2 P. M.	9 P. M.	Mean.	Direction of Wind.	Miles of Wind.	Face of Sky.	Mean Humidity.	Rain Fall—Inches
1	10.0	36.0	26.0	24 5	S W	50	Clear,	69.8	....
2	24 0	49.0	40.0	38.2	S W	475	Clear,	52.1	....
3	36.0	37.0	41.0	38.7	S W	434	Cloudy,	97 7	1 25
4	40.0	39.5	35.5	37.6	N W	202	Cloudy,	76.7	....
5	31.0	33.5	31.0	31.6	N W	747	Cloudy,	77.4	0 10
6	27.0	42 0	36 0	35 2	N W	525	Half clear,	68.1	....
7	28.0	49.5	31 5	35 1	N W	323	Clear,	67.8	....
8	26.0	44.5	34.0	34 6	S W	50	Clear,	64 3	....
9	36.0	56 0	35.0	40.2	S W	596	Clear,	49.3	....
10	36.0	57.0	54 0	50 0	S	384	Half clear,	55 3	....
11	42.0	67.5	57.5	56 1	S W	475	Clear,	55 5	....
12	44.0	68 0	43.0	49 5	Var	515	Clear,	60.3	....
13	33.0	55 0	35.5	39.7	N W	181	Clear,	64 6	....
14	34.0	58.5	51 0	48.6	S W	252	Clear,	63.3	....
15	51.0	65.5	59 5	58.8	S W	363	Clear,	55.5	....
16	59 0	64.0	60 0	60.7	S E	70	Cloudy,	85.4	0.01
17	60.0	63 0	62.0	61 7	S E	222	Cloudy,	92.2	0.40
18	58.0	63.5	62 0	61 3	S W	333	Cloudy,	83.7	0.05
19	56.5	62.0	60.5	59 8	S W	343	Half clear,	83.4	....
20	46.5	65 0	55 5	55.6	S E	242	Clear,	76.8	....
21	48.5	64 0	56.0	56 1	S E	424	Half clear,	80.2	....
22	52 0	60.0	52.5	54.2	S W	363	Cloudy,	84 1	0 15
23	43 0	54 5	43 0	45.8	N W	171	Half clear,	75.7	....
24	37 0	53 0	44.0	44.5	N E	131	Cloudy,	72.9	....
25	37.0	40.0	38.0	38 2	N E	404	Cloudy,	84.7	0.02
26	37 0	43 0	40.5	40 2	N	51	Cloudy,	98 9	0 01
27	40.9	42 0	39.5	40.2	N E	101	Cloudy,	86.7	0 02
28	36.0	39.0	37.5	87.5	N	161	Cloudy,	85.7	....
29	34.5	35 0	32.5	33.6	N W	646	Cloudy,	96 5	0.20
30	30.0	35.0	34.0	33 2	N W	777	Cloudy,	80 8	....
31	29.5	37 5	32 0	32 7	N W	192	Clear,	70.9	....

MISSOURI METEOROLOGY FOR DECEMBER, 1877.

BY PROF. FRANCIS E. NIPHER.

MISSOURI WEATHER SERVICE,
CENTRAL STATION, January 4th, 1878.

The December just past was remarkable for its abnormal temperature. The mean at the Central Station being 45.6°, which is 12.4° above normal, and 2.7° above the normal November. At Lexington, a mean of 43.8° is reported.

At Troy, (Dec. 7), seeds of asters, hemp, mustard, etc., were observed germinating in open ground, as in April.

At Lexington and Clinton, rose, peach, lilac and other buds were unfold-ing, and at the latter place, strawberries were reported in bloom. At Lexington, the eggs of the "fly" were hatching in large numbers in the wheat fields—(24th). A rainbow was seen at Clinton at 4 P. M. on the 22d, and half an hour later at St. Louis. Lightning at Poplar Bluff, 24th. At St. Louis, earth-worms came to the surface in immense numbers on the 24th, and frogs were heard on the 18th at Lexington and St. Charles.

The rainfall at St. Louis was 3.24 inches, a slight excess over the normal, which is 3.03. In the State, the rainfall was least in the northwest; being 1.30 at Corning, 1.68 at Hopkins, but increasing regularly towards the southeast, being 1.98 at Pleasant Hill, 2.70 at Clinton, 4.05 at Ironton, and 4.55 at Poplar Bluff.

At the Central Station, the highest temperature reached was 69° on the 12th, the lowest was 19° on the 2d. (At Lexington the maximum and minimum were 67° and 15°).

The total run of the wind for the month was 7,742 miles, an average of 250 miles per day. The highest daily run was 495 miles, on the 30th; the lowest was 117 miles, on the 17th.

Washington University, St. Louis.

ASTRONOMICAL NOTES FOR JANUARY.*

BY PROF. C. W. PRITCHETT, GLASGOW, MO.

VENUS.—In the telescope, Venus is now a sharp and beautiful crescent, closely resembling the Moon seen in twilight when four days old. Along the *inner* edge of the crescent are numerous irregularly shaped notches, which plainly reveal the inequalities of her surface. Though her illuminated surface is constantly *diminishing*, she will continue to grow *brighter* to us, till January 16. This is because her *distance* from us is constantly diminishing. After this date she will diminish in brightness till February 20, when she will be in inferior Conjunction, and consequently *invisible* to us. Soon after this latter date, she will reappear in advance of the Sun, as the Morning Star.

MARS.—Mars is now near the Meridian at sun-set, and appears wonderfully shorn of his recent glories. Micrometer measures of his diameters, both from east to west and from north to south, made here about Sept. 1st, gave about 25.5″ of arc. His diameters have now fallen to 8.5″, showing that he is $3\frac{1}{4}$ times as far from us now as he was at opposition, Sept. 5. Still he is a conspicuous object in the southwest sky, in the early hours of the night. In the telescope, he still shows the vast accumulations of snow and ice near his south pole. Also the outlines of his seas and continents are still visible. But the change is *vast* from the splendid views he gave us in August and September. His opposition for 1877, will henceforth be *memorable* in the history of Astronomy. 1. For the *first time* his satellites

* This article was received too late for insertion under the proper heading.—[ED.

were revealed. 2. His physical markings have been accurately delineated at numerous observatories. 3. His relative mass is now known. 4. Observations on his position relative to fixed stars, will have an important bearing in the *final value* adopted for the Solar Parallax. A number of drawings showing the physical markings of Mars, were made at this observatory. Made at different hours of the night, they differ much among themselves, as *successive* parts of the planet were turned towards us. Some of these closely resemble the drawings of Mr. Lockyer, made for the opposition of 1862.

SATURN.—In early twilight, Saturn is now seen in the southwest sky, about 30° west of Mars, on the Ecliptic. The northern surface of his rings is still visible in large telescopes—the Earth being elevated only 2°+30′ above the plane of the rings. But an unpracticed observer would only note a sharp straight line extending across the ball to the distance of 18″ east and west. On February 6, even this *sharp line* will disappear, since the Earth will then be situated exactly in the plane of the rings. This disappearance will last till March 1, when the Earth will have crossed the plane of the rings, and will have attained an elevation of less than 1′ on the south side. This disappearance and reappearance of Saturn's rings, occurs every $14\frac{3}{4}$ years. During next year the rings will begin gradually to open again; but several years must elapse before the rings will *so open* as to present, even in powerful telescopes, their distinct and magnificent phases. The satellites of this planet still present a splendid retinue, and their conjunctions with the ends of the ring and the edge of the ball, have been closely observed at the Morrison Observatory, for the last two years. The observations may be seen in astronomical journals.

THE CONSTELLATIONS.—About 10 o'clock, Orion is just east of the meridian to the south. Farther north the Pleiades and Hyades have crossed it. Auriga, with the glorious star Capella, is nearing the zenith. Northward is Perseus in the variable Algol, and in the northwest Cassiopeia on her "royal seat." There is just then a marshalling of the "hosts of Heaven," which is excelled at no other hour of the year. Under the open canopy in such an hour even the naked-eye observer may well exclaim, "How marvelous are thy works, O Lord, Almighty." But to read those works as revealed in a powerful telescope, turned on such objects as Sirius with his faint companion—the Nebula in Orion—the triple star Andromeda, or the dual clusters in Perseus, like "diadems on the brow of night," is surely a privilege not lightly to be thrown away.

Morrison Observatory, January, 1878.

BOOK REVIEWS.

A GUIDE TO THE DETERMINATION OF ROCKS: Being an introduction to Lithology. By EDOUARD JANNETTAZ, Docteur es-sciences. Translated from the French by Geo. W. Plympton, C. E., A. M. D. A. Van Nostrand, Publisher, New York. For sale by Matt. Foster & Co. Price $1 50.

This is a duodecimo volume of 165 pages, intended by the translator, who is Professor of Physical Science in the Polytechnic Institute, Brooklyn, N. Y., as a desirable supplement to the ordinary Academic course of geology and an easy introduction to the larger treaties on Lithology. How far it will accomplish these objects depends largely upon the advancement made beforehand by the student in crystallography and microscopy, upon which to some extent the determination of rocks as taught in this work depends.—However, in most respects, it is plainly written, and well adapted to the wants not only of the class for whom it was prepared, but also for practical workers in the field.

The introduction is a concise description of rocks, divided into Crystalline, Sedimentary and Eruptive, their origin, formation constitution and modifications.

Part I. is devoted to the principal physical and chemical properties of the mineral species which compose the rocks, such as Feldspars and the minerals allied to them: the Micas, the Chlorites or talcose Micas; Talc and Steatite; Amphiboles, as Hornblende, etc.; Pyroxenes; Mineral species occasionally appearing as essential elements of rocks, like Topaz, Tourmaline, Garnet, etc.

Part II. is devoted to a description of rocks and the minerals which compose them, and consists of a more minute examination of the same classes or species named above with their dominating and essential elements and their accessory and accidental elements.

In Part III., the author first presents the prominent characteristics of rocks which enable the student to refer any specimen under consideration at once to a certain group, and after that gives the method of determining its precise order and name.

Part IV is translated from the elementary course of applied geology by M. Stanislaus Meunier, and gives the Dichotomic table for determining rocks.

As an illustration of the manner adopted by the author, we reprint part of the chapter descriptive of Metallic Rocks in Part II.

SULPHIDES AND SULPHO-ARSENIDES.

Heated on charcoal with carbonate of soda, they yield sodium sulphide which blackens lead paper or silver foil. Heated in the oxidizing flame, they yield sulphurous acids.

Galena.—Lead Sulphide (Pb S). Dominant forms: cube, octahedron, and a combination of these two; sometimes the facets of a rombododecahedron. It has three rectangular cleavages; a metallic lustre. Color: steel gray; powder: grayish black. It is easily fused. Heated on charcoal it gives a lead globule and yellow coating. With Potassic bisulphate it yields sulphuretted Hydrogen.

Varities; Laminated; foliated; granular; compact.

THE GEOLOGICAL RECORD FOR 1875. An account of works on Geology, Mineralogy and Palæontology, published during the year; edited by William Whitaker, B. A., F. G. S., of the Geological survey of England. London: 1877.

This is a valuable work of 443 pages, octavo, for the use of students and investigators, as it contains an account of all that has been published during the year on Geology, Mineralogy and Palæontology. It gives the name of the author, the title of the book or paper, where and when published, and in most cases a short abstract of their contents. The authors' names are arranged alphabetically under the different divisions of The British Isles, Europe, America, Asia, Africa, etc.; this, with a very full index, adds much to its convenience as a work of reference.

The cost of publishing this work is partially defrayed by a grant from the British Association, but yet the publishers feel the need of additional funds for the purpose of distributing it still more widely.

As a work of reference for Geologists, Mineralogists Palæontologists, it must necessarily be very valuable, and should be in every public library.

AROUND THE WORLD. By E. R. Hendrix, A. M., with an Introduction by Rev. Bishop Marvin: pp. 598, 12mo. Nashville: A. H. Redford; St. Louis: L. D. Dameron; 1878. For sale by Matt. Foster & Co., $2.00.

This is a Missouri book, witten by a Glasgow minister, who made a trip around the world in 1876 and 1877, for the general purpose of sight-seeing, and for the special purpose of examining for himself into the missionary work going on in foreign lands. Mr. Hendrix is endorsed by the late Bishop Marvin, of St. Louis, as "a first-rate traveler, thoroughgoing, painstaking, energetic, readily adjusting himself to new situations, and with a quick eye for new and striking facts, as well as that hearty interest in all human affairs which keeps him fully awake to all important events, and puts his powers of observation at their best."

Upon looking over this book we find it written in a sprightly and vivacious manner, at the same time giving descriptions of men and things observed in an accurate and attractive style. The author simply asks for the work a place in every Sabbath school library of the church, but it is entitled to a more prominent place than that, and will undoubtedly find it.

Starting at Kansas City, October 18, 1876, he describes his rapid course across the plains, the mountains, and the Pacific ocean, arriving in Yokohama December 1st. During the next nine months, he visited the principal points of interest in Japan, China, India, the Holy Land, Turkey, Greece, Italy, Switzerland, Germany, France and England, reaching New York August 17, 1877.

There is nothing profound in the work, and nothing perhaps very new to the scholar, but for family reading it is as acceptable and interesting as any of the kind lately put forth.

Being a strictly western book, and written by a well known and popular pastor of the Methodist church, it will undoubtedly have a large sale.

EDITORIAL NOTES.

During the holidays we made a flying trip out the Kansas Pacific Railway as far as Manhattan, and while there visited, und-r the friendly guidance of Mr. Stanton, of the Adams House, the State Agricultural College. Unfortunately for us, we found none of the Faculty of the College at home, but were well repaid for our visit after all. We were greatly surprised at the extent as well as the excellent quality of the means of teaching the youth of Kansas the various branches thought necessary in that liberal State for the education of its working class, such as cabinet making, the manufacture of agricultural implements, telegraphing, printing, practical geology and chemistry, music and sewing. The chemical department under Prof. Kedzie, is one of the most complete and best adapted to the purpose we have ever seen. Upon visiting the office of the *Industrialist*, which is edited by Prof. Anderson, we found several of the students busily engaged in setting type, and the quality of the work done by them is sufficient evidence that they are in the hands of good and faithful instructors in this department as well as all the others. Kansas has reason to be proud of its public schools, of all grades, from the University down to the District schools away out on the borders.

The Kansas City Academy of Science will hold its regular monthly session on the evening of January 27th, at which time an unusually interesting meeting may be expected. A paper upon "The Atmosphere" will be read by Col. R. T. Van Horn, President of the Academy; one upon "Meteors" by Prof. Broadhead of Pleasant Hill; one by Miss Murdfeldt, of St. Louis, upon "Entomology." After which Prof. Crosby will display the very rare collection of curiosities brought home by him from Europe,

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The Lecture upon the Telephone by Prof. Kedzie of the Kansas State Agricultural College, was necessarily postponed on account of the extremely disagreeable weather prevailing at the proposed time of its delivery. It will be delivered at an early day, illustrated by several large charts and twenty instruments.

We are much gratified at being able to present in this number of the Review the first of Prof. Pritchett's Astronomical Notes, and to announce that in the February number we shall publish an article by the same noted astronomer upon the *Occultation of Venus* with six fine illustrations of actual observation by him with the large telescope at Morrison University.

It is extremely gratifying to western engineers that Capt. Eads has succeeded so completely in all his calculations and operations at the mouth of the Mississippi in spite of the predictions of failure by many of the prominent army topographical engineers, and is now about to receive the second instalment of $500,000 due him.

THE next (February) number will complete the first volume of the REVIEW, and it may not be amiss to call attention to the fact that quite a number of those who have received it regularly during the year, are yet in arrears.

WITHIN the past few days a Mining and Stock Exchange has been organized in this city, which will soon be followed by smelting and refining works, and, it is not at all improbable by a branch of the United States mint within a short time.

PROF. SINKS delivered his third lecture upon Elocution before the Leavenworth Academy of Science, January 3rd, and from his well known reputation for ability and scientific attainments as well as from the newspaper reports of them, there is no doubt that they are both interesting and instructive.

THE young men of the High School and their associates, have recently started an attractive little periodical called the *Philomathean*, which, if kept up with the same ability manifested in the first number, will prove an interesting and beneficial work.

WE shall publish in our next number an exhaustive article on the subject of *Meteors* by Prof. Broadhead, which will be illustrated with engravings from photographs of some of the largest and most interesting which have fallen in Missouri.

AT this writing, January 12th, the weather is warm and pleasant. No ice has yet been harvested and cattle and other live stock have continued to graze in the open pastures, while but a few days since the fruit trees were budding forth, such annuals as Morning Glories were sprouting, and the Snap Dragons of last year were yet green in the flower beds.

THE cause of the late disastrous explosion in the candy manufactory in New York, has given rise to many explanatory theories. The most satisfactory seems to us to be that which attributes it to the sudden ignition of the cloud of starch particles floating in the air of the room where the explosion occurred. Such ignition of the finely powdered dust in coal mines is generally recognized as one sufficient cause of violent explosions occurring there, and we have all witnessed the same thing on a smaller scale when throwing a quantity of coal dust into a hot fire at our own homes; also, in the manufacture of stage lightning in theatres by the burning of lycopodium and other finely powdered substances.

NOTICES OF PUBLICATIONS RECEIVED.

Since our last issue we have added to our exchange list the JOURNAL OF THE FRANKLIN INSTITUTE, published by that body at Philadelphia. This is one of the oldest Scientific periodicals published in the United States, and has always maintained a high standing among such works. $3 per annum.

CAPT. HOWGATE of the *U. S. Signal Scrviee* has favored us with a copy of a pamphlet recently published by him upon *Polar Colonization*, which is descriptive of the objects and purposes, a well as the actual transactions of the Preliminary Arctic expedition of 1877. We shall make use of the information furnished in our next.

THE January numbers of the various Scientific magazines have come to hand with at least their usual promptness, some retaining their former well known externals, and some considerably improved in appearance: all, however, fully maintaining their standards of excellence:

THE POPULAR SCIENCE MONTHLY, from which we reprint a very interesting editorial on "Sun Spots and their Effects," has a most attractive table of contents, and is well worth to any reader the five dollars per annum that it costs.

POPULAR SCIENCE MONTHLY—SUPPLEMENT—published by the same enterprising house, D. Appleton & Co., New York, presents monthly the choicest selections from the best European scientific journals. Price $3.00 per annum.

THE NORTH AMERICAN REVIEW, now in its 63d year, shows more brilliancy than at almost any other period of its existence, at the same time that it has lost none of the scholarly ability which has always marked its articles. Its present editor, Allan Thorndyke Rice, evidently intends to keep it fully up to the times in every respect. Price $5.00 per annum.

Van Nostrand's Engineering Magazine is one of those substantial, reliable journals that engineers and mathematicians most enjoy, being strictly technical and precise, and as purely scientific as anything published in either hemisphere. Price $5.00 per annum.

American Journal of Science and Arts, being a continuation of what was so long known as Silliman's Journal. It is now nearly sixty years old, and is probably more widely known throughout the scientific world than any similar publication in the United States. Price $6.12 per annum.

The Engineering and Mining Journal, weekly, devoted to mining, metallurgy and engineering. It is ably edited by Professors Rothwell and Raymond, and is the only eastern scientific journal which gives any prominence to wesntern mining matters; consequently it is a favorite throughout the west and on the Pacific coast. $5.00 per annum.

The American Naturalist, devoted to the natural sciences in their widest sense, is also one of the standard authorities on all branches of Natural History, and has a corps of contributors unsurpassed for ability and scientific attainments. We have frequently, during the past year, availed ourselves of its columns for articles for the Review. The office of publication has been changed to Philadelphia, beginning with the present number. Price $4.00 per annum

Boston Journal of Chemistry. Vol. 12, No. 7, edited by Prof. J. R. Nichols, M. D., and Wm. J. Rolfe, A. M., is deservedly one of the most popular periodicals published in the country, both from its low subscription price ($1.00) and the variety and value of its contents.

Scientific American. As we have before asserted in these columns, the *Scientific American* is an indispensable thing to mechanics, artisans, engineers, and to almost all classes of working people, whether they work in shops, laboratories, factories, or in the fields. It is admirably illustrated besides. Price $3.00 per annum.

Mines, Metals, Arts and Railroad Journal, J. E. Ware & Co., St. Louis. This is a weekly journal, devoted to mines, metallurgy, chemistry, manufactures, technics, engineering, railroads and markets. It is edited with ability, and presents a most creditable appearance. To those desiring information on western mining and metallurgical matters, it will be found very useful. Price $2.00 per annum.

New York Medical Journal, edited by James B. Hunter, M. D. A., published by D. Appleton & Co. It stands high among Medical Journals and has on its list of contributors some of the finest and most able medical writers of the whole country. Price $4 per annum.

Science Observer—Published by the Boston Amateur Society. Edited by J. Ritchie, Jr., and associates. Devoted more especially to Astronomy. It is a modest paper in size, but manifests a good deal of spirit and talent in its articles. Fifty cents per annum.

The Phrenological Journal, now in its 66th volume, presents an improved appearance, at the same time that it has been reduced in price to $2 per annum. Many valuable articles are to be found in its pages.

We receive the *Kansas Farmer*, the *Gardener's Monthly* and the *Quincy Agriculturalist* with the utmost regularity, and can heartily recommend them as most readable, reliable and valuable periodicals in their respective departments.

Of the literary Journals that we receive none excel Appleton's Journal and the Library Table, for valuable reading matter, whether for stories, critiques or editorial comments upon current topics.

In addition to the periodicals and journals above noticed, we have received numerous others, which have been and are warmly welcomed by us, and which will have attention hereafter.

As remarked in our last number, we can furnish any one of the above named journals with the Review at much less than the regular price of the two separately.

THE

WESTERN REVIEW OF SCIENCE AND INDUSTRY.

A MONTHLY RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

VOL. 1. FEBRUARY, 1878. NO. 12.

ASTRONOMY.

OCCULTATION OF VENUS, DECEMBER 8, 1877.

BY PROF. C. W. PRITCHETT, MORRISON OBSERVATORY.

This phenomenon was witnessed over all the Western States, particularly north of the parallel of 38°. To the astronomer it is gratifying to know how *very general* was the interest taken in its occurrence. This interest was not confined to the educated, but was shared by the most unlettered and even by young children. Hesperus, the glorious Evening Star, which in Eden

"* * * * Led the starry hosts, and brightest rode,"

has in all ages been an object to compel the attention and admiration of beholders. But to find it on a clear, calm evening, first in close proximity to the Moon, and next suddenly obscured by it, as if blotted out of Heaven, surprises those unaccustomed to such events, and powerfully awakens popular interest in celestial phenomena. Yet this event is only *one* of a class. Kindred phenomena occur almost daily. Though unseen in America, Venus herself is occulted twice during the year 1878—January 6th and August 25. Also during the year the planet Jupiter will be occulted ten times, Mars twice, and Uranus three times. The Solar Eclipses, of which two occur in 1878, are but occultations of the Sun. The occultation of the planet Saturn in August and September, 1876, was a rare astronomical event. The immersion and emersion of the edge of the ball, and of the ansæ of its ring, and the appearance of the Moon's limb in the void space between the ring and the great ball, were observed with marked interest by astronomers. The reader may find an account of the Washington observations of this occultation as observed by Prof. Hall and others, in the "Astronomische Nachrichten," No. 2107. He may also find accounts of the occultation of Jupiter, January 2, 1857, in Month. Not. R. A. S., Vol. XVIII; also of the occultation of Saturn, May 8th, 1859, Month. Not. R. A. S., Vol. XIX. The occultation of the beautiful planet Uranus, was very carefully observed at the Morrison Observatory, Glasgow, Mo., April 21, 1877.

Moment of first contact or beginning of partial phase, 13*h.* 28*m.* 43.5s. Gl. Sid. Time.
Moment of internal contact or beginning of total phase, 13*h.* 28*m.* 47.5s. Gl. Sid. Time.

The external contact of emersion occurred at 14*h.* 18*m.* 50.5*s.*, hence the planet was *entirely concealed* by the Moon, 50*m.* 3.5*s.* The occultation of one planet by another planet than the Moon, is of *exceedingly* rare occurrence. Such was the occultation of Mercury by Venus, May 17th, 1737. The occultation of a *first* magnitude star is an astronomical event nearly as interesting as that of Venus. Four such stars lie near the Moon's path, and are liable to occultation. They are Aldebaran, Regulus, Spica and Antares. The accurate observation of the immersion and emersion of *all* well determined stars, furnishes to the astronomer the best purely *theoretical* method of computing differences of longitude. In such observations the notation of the precise instant of appearance or re-appearance, is of the utmost importance. This notation is made by the Electro-Magnetic Chromograph, and is instantaneous. The clock or chronometer error is ascertained in the same way from meridian transits of stars. Aside from the error of personal equation, the clock correction may thus be obtained to the $\frac{1}{100}$ part of a second.

With these preliminaries, I return to the occultation of Venus. The evening at this Observatory was as favorable as possible. The sky was cloudless, and temperature agreeable, being 37 Fahr. in the open air. Many persons noted by watch the moment of disappearance. This was the only phase *distinctly* cognizable by the unassisted eye. But in a large telescope there were present several phases of very great interest. I will try to describe them, not for anstronomers, but for the young and the plain, practical people, who have shown so much interest in the event. I shall speak of the phenomena as they appeared in the field of a large refracting telescope, under an amplifying power of 250. In such a field all the images are *inverted*—up and down—right and left—east and west—north and south, all exchange places. The diagrams, I send with this text, are intended to show the phases, as seen in the field of the telescope. Again, since in a large instrument, with even a moderately high eye-piece, only a very *small* portion of the Moon's surface can be seen, while the whole *visible* surface of

Venus occupies a conspicuous part of the field, there is no way to secure the *just optical effect*, but by drawing Venus with an *apparent diameter* far greater than is due. Strictly, the lunar diameter should appear 73 times greater than that of Venus. Hence, if the apparent diameter of Venus be taken $\frac{1}{10}$ inch, the apparent diameter of the Moon *should be* 7.3 inches. Even the scale I have adopted in the diagrams scarcely gives the full optical effect, since the perfect semi-circle of Venus, with its dazzling brightness, was full advanced in the field, while only a small segment of the Moon could be admitted.

The *unassisted* eye could readily see, beside the bright crescent of the Moon, the dark portion of her disc, rendered visible by the reflection of light from the Earth. This feebly lighted surface, exhibiting what is called the "ashy light," (*la lumière cendré*) exists in Venus just as in the Moon, only it is barely distinguishable on very clear evenings, in powerful telescopes. On the evening of December 8, Venus was only three days from her greatest eastern elongation, and hence her disc was almost perfectly divided into semi-circles—one brilliantly lighted by the Sun's direct rays, the other entirely dark—even the "ashy light" fading out in presence of the Moon. For half an hour, to the unassisted eye, Venus seemed to stand still on the northeastern limb of the Moon, on the very border of "ashy light." Some grew weary of watching it, and thus missed the moment of immersion. At 5:20, Glasgow mean time, the images of the Moon's dark limb and of Venus were brought into the field of our Clark Refractor—the bright semi-circle of Venus being turned towards the Moon's dark limb. The limbs were then separated by an interval of three or four minutes of arc. The purity of the air showed the Moon's dark limb to great advantage—the sky beyond appearing intensely black in contrast with the "ashy light." The border was most distinctly marked, and I patiently watched the gradual approach of the bright and ashy discs, with finger on the break-circuit key, so as to note on the Chromograph the moment of contact. The view was rare and beautiful. Even the brightest fixed star exhibits no *real* disc; but here two great spheres, projected as circles, were rapidly approaching each other.

When the bright limb of Venus was within eight or ten seconds of the Moon's "ashy limb," a phenomenon occurred which has always been noted in a *superior* degree in the transits of Venus across the Sun's disc. It may afford some indication of the *extent* and *density* of the atmosphere of Venus. Instead of a *sharp, closely defined* contact of discs, which was so fully promised, a border of wavering light, several seconds in width, seemed to precede the planet. This irradiation was such as to place the moment of external contact in doubt, by perhaps *one* second. The instant noted was 22*h.* 48*m.* 15.52*s.* Gl. Sid. time—corresponding to 5*h.* 36*m.* 55.94*s.* Gl. mean time. This time must be taken rather as the instant of first *appreciable encroachment* on the bright limb of the planet. The effect of this bright arc of light was such, in transit observations of the British expeditions of 1874, as to place the moment of *internal* contact in doubt by five or six seconds, and to cause the *rejection* of all observations of this phase in computing the Solar Parallax. From this occultation of Venus, I feel sure that no part of *that effect* can be due to the Solar Corona; but must be ascribed either to irradiation and diffraction or to the disturbing effect of the atmosphere of Venus. The phase of external contact, which could not be observed by the unaided eye, is illustrated in Diagram No. 1. It marks the *beginning* of partial phase at immersion. The curve of the Moon's dark limb, projected on the bright semi-circle of Venus, now rapidly advanced towards the straight line or diameter, dividing the enlightened and unenlightened halves. This line is called the Terminator, and is marked by the letters *n, s,* in all the figures. In 31.11*s.* (seconds), the curve reached the northern point or cusp of the planet, as shown in Diagram No. 2. This cusp was simply *blunted*, but there was no disturbing arc of light, and the time was instantaneously noted, at 22*h.* 48*m.* 46.63*s.* Gl. Sid. time, or 5*h.* 37*m.* 28.2*s.* Gl. mean time. Now began the most *interesting* part of the phenomena. As the arc advanced, the curve cut off more and more of the sector-like surface yet illuminated. But 18.99*s.* now remained, and in that brief space there was much to see. They were moments of intense excitement, as I watched that triangular surface of light, bounded by two curves and a straight line, gradually fading into nothingness.

Fig 1

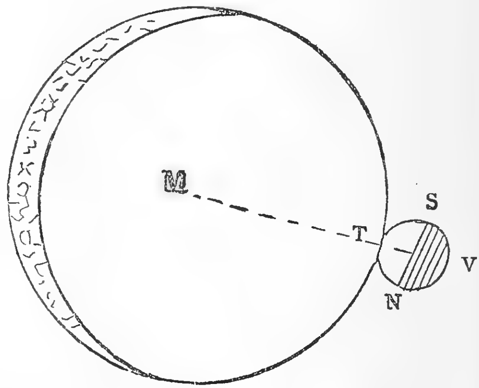
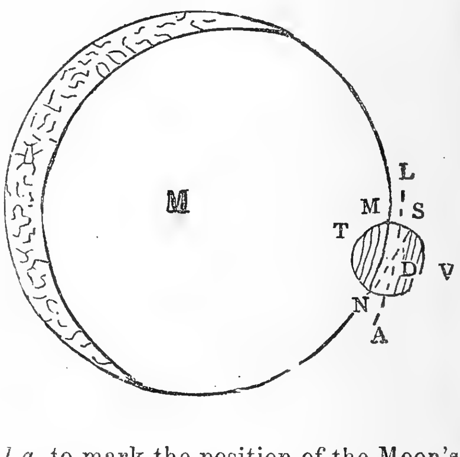


Fig 2



In figure 2, I have drawn the arc *l a*, to mark the position of the Moon's limb and the rapidly vanishing surface of light, but six or eight seconds before the beginning of total phase. In a few seconds more the southern cusp shot out its *last ray* and Cynthia had vanquished Venus. See Diagram No. 3. This instant was noted at 22*h.* 49*m.* 5.6*s.* Gl. Sid. time, corresponding to 5*h.* 37*m.* 47.14*s.* Gl. mean time. At this time however, all the dark lune of Venus, bounded by the curves *m s* and *m v s*, was still projected beyond the Moon's "ashy limb."

In the emersion, first came the internal contact of discs. See Diagram No. 4. This marks the close of the total phase. Occurring on the Moon's

Fig 3

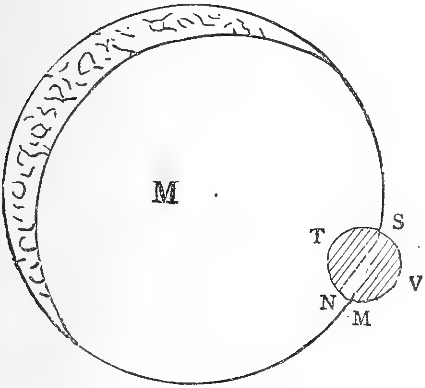
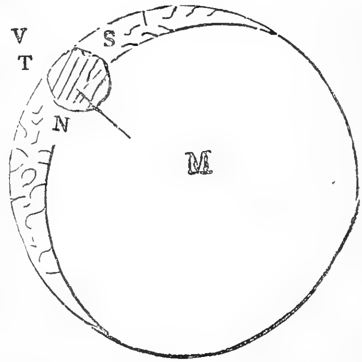


Fig 4



bright limb, the time of its occurrence, or rather the instant of *first light* from the rim of Venus, could not be so distinctly noted as the moment of the preceding phases. I therefore used the time to change the position of the dome and shutters, and noted neither the time of internal contact nor the *emersion* of southern cusp. See Diagram No. 5. The emersion of the

Fig 5

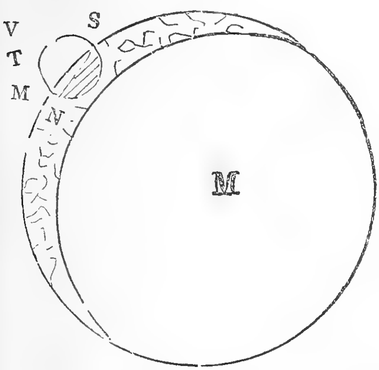
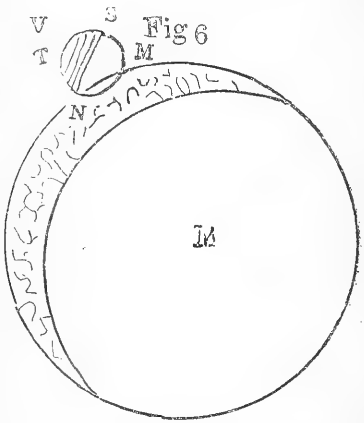


Fig 6



northern cusp is shown in Diagram No. 6. It was observed at 23*h*. 58*m*. 15.27*s*. Gl. Sid. time, or at 6*h*. 46*m*. 44.16*s*. Gl. mean time; the duration of the phenomenon, from first contact to the emersion of the northern cusp being 1*h*. 9*m*. 59.75*s*. The clock error of the night of December 8, was most carefully ascertained by meridian transits of seven standard stars—the observations being reduced by the method of least squares. Hence, any person so disposed, may confidently use phases two and three for computing differences of longitude from Washington or Greenwich. For any such I will add that the latitude of the dome of the Observatory has been rigorously determined, and found to be 39° 16′ 16.75″ + 0.05″.

MORRISON OBSERVATORY, January 24, 1878.

METEOROLOGY.

ABOUT THE ATMOSPHERE AND ITS PHENOMENA.

BY HON. R. T. VAN HORN, KANSAS CITY, MO.

This globe on which we are is the great mystery. Science tells us that it is suspended in space—moving with a velocity that the imagination cannot grasp, it keeps its ceaseless round—bringing its day and its night and its alternating seasons, since the morning of matter; an incomprehensible mystery that has been the wonder of our humanity, into whose secrets the intellect of man has delved in all the ages as containing the answer to the question of how and why he exists?

With this solid globe, ever present, all pervading, obeying the same law as to fixedness and movement, is a fluid ocean, impalpable to sense, that we call the air or atmosphere—a mystery more subtle, more incomprehensible than even the seemingly solid mass of matter it envelopes. In it all the phenomena of life are manifested, and from it all life exists or is possible. It is the theatre, so to speak, on which transpire those displays of the elements which charm by their beauty, confound by their mystery or awe by their majesty and power. The zephyr and the storm are equally its children; the glories of sunset entrance us by their coloring, while the glow of the aurora appeals to the weird sense of the supernatural by the rapid shifting of its mysterious scenery. It spreads above us its canopy of blue, fit field for the god of day; at night it wraps the Earth in a robe resplendant with shining jewels. It is, too, the same air when the curtain of the storm hides this glory of the day or beauty of the night, proclaiming its angry power by its lightnings and thunder.

It comes also to reviving nature in the gentle breath of the warming south wind, kissing the flowers as they bend their congratulations to its coming; and on its wings comes the north wind, congealing life in the elements for their winter's rest—the one messenger of life and of death. By it the bracing breezes of health are scattered over the earth, and in its train pestilence stalks from continent to continent, the terror-invested mystery that chills the nations with dread. What is this wonderful thing?—so common, yet so little known—and whence was it, or from whence is it?

Science tells us it is a material thing—that it is composed of elements that can be weighed and measured, and that it has all the qualities of matter—can be compressed or expanded. In short, speaking chemically, it is composed of nitrogen, oxygen, carbonic acid, ammonia, ozone and vapor of water—mainly of the first two, in the proportions of four volumes of nitrogen to one of oxygen. Its weight we may place in round figures at fifteen pounds to the square inch. Its height, judging from the barometer at the highest elevations attained for observation, would be about thirty miles. Its theoretical height—that is the point at which gravity would cease to control it with the Earth's rotation—is twenty-one thousand miles. That it does not extend thus far optical experiment demonstrates.

These formula as to the air are from the latest and best authorities. And here it may be proper to state, that when any data are used, they are taken from accredited authority—they are not mine—they may be taken as facts; only the conclusions, good or bad, may be laid to this paper, and are alone chargeable to it. This statement is necessary because it is impossible in an hour to give references, to say nothing of quotations. It is only from these facts coming under notice in the desultory reading of a journalist, that I have ventured to ask a few questions as to the nature of these facts, or the origin of the element to which they belong.

The above is the chemical composition of the air—or rather what chemical experiment has determined as the elements composing the atmosphere.

We must not make the common mistake, and designate the air as a combination of these elements in a chemical sense—for it is not. It is simply a mixture of these gases. A chemical combination of two or more substances always produces a new one—or a substance differing in quality from any of its components. Water is oxygen and hydrogen combined—a chemical combination—air is simply a mixture. And in determining the offices of the atmosphere, and investigating its phenomena this fact is of fundamental importance.

And now, before inquiring into the nature of the atmosphere, let us first examine the commonly accepted theory of the phenomena witnessed, and its primary movements that we call the wind. For if this theory accounts for these phenomena satisfactorily, mere conjecture as to something else is not only waste of time, but without apology. And this commonly accepted theory is nearly two hundred years old—and has been endorsed by what the scientific world recognizes as regular authority.

The popular idea is that the atmosphere is a distinct element, or creation, enveloping the earth—constant and unchangeable—and which is of itself inert and without individuality, so to speak—a plastic element, moving as impressed by external agency—and that agency heat from the Sun.

The most noticeable of atmspoheric phenomena are the winds. Halley, in 1686, as a mere hypothesis, proposed what has ever since been accepted as a fact or law—that the movement of the air—or winds—was due to the Sun's heat, and that all the varied manifestations, from the zephyr to the hurricane, were the results of this agency in modified or intense activity.

The most constant and noticeable of all these movements are the trade winds, which blow from both sides of the equator toward it. This fact was the origin of the theory, but the cause of the fact, as given in the theory, does not accord with observations since. The theory of Halley was briefly this :

(1) That at the equator or within the tropics, where the rays of the Sun are vertical, and constant in intensity, the surface air becomes heated, and expanding, rises, creating a vacuum, and as this is an abhorrent thing to nature, the air from the cooler surfaces rushes in to fill it—or as the latest cyclopedia has it: "to fill the spaces left by the airs that have become heated and passed up to the more elevated portions of the atmosphere in the belt of the equatorial calms."

(2) That this heated air, rising to a supposed height in an immense column of several hundred miles diameter, divides in the upper regions and flows off to the respective poles, supplying in its turn the place of the cooler air drawn inward to the centre—making a circulation by two complete circular currents coincident with the hemispheres of the globe. Here, then are two vacuums, in permanent existence, or rather a continuous vacuum of which the wind is in constant pursuit. If this is the law of atmospheric movement, it must be consistent in all its parts—the lesser motion as well as the grand movement of the whole.

Now, what do we know? Take, almost any day in the year, a weather chart of the signal office, on which is marked the direction of the wind at a given hour all over the American continent, and what do we find?—the wind as varying in its direction as the points of the compass. At Kansas City a north wind, at Omaha a south wind, at Denver an east wind, and at St. Louis a west wind. At Fort Scott, southwest, at Laramie northwest, at Chicago northeast, and New Orleans southeast. As changeable as the wind, is a proverb as old as human observation.

Then again, as we all know, here and all over Southern Kansas, we may be to-day basking in the mildest weather that a southern breeze can bring us, or we may be sweltering with the torrid heat of summer, while at the very same hour a fierce and chilling norther may be sweeping down the plains of Texas. Or, we may ourselves be chilled with the raw breath of an east wind, while above our heads in plain view from the west, is a warm river of air flowing onward, bearing in its current the warm rain, and flashing with the lightnings evolved from its latent heat. These things we see and know, they are not consistent with such a law as we have been considering. These facts have led to the question—is this theory, old as it is, supported by so much authority as it is, true? Is this theory based upon the general law as to expansion by heat, and illustrated by the trade winds, the fact? It is proposed now to test it by the record of the thermometer, kept for a long series of years, both in the latitudes where this heating process is supposed to be going on, and where the vacuum is created, as also in the latitudes where the cooler portions are assumed to be, from which the refrigerated winds flow to the thermal vacuum, and over which they blow. And we shall not only show that this assumption is not warranted by the facts, but that these trade winds actually do blow from surfaces more highly heated than those into which they blow—and that their movement is from a higher into a lower temperature. The tables used are mainly those of

Kaemtz, Dr. Barth, Prof. Coffin, and others—covering long series of years, and at all seasons.

Commencing on the west coast of Hindostan, we have a table by Kaemtz in his treatise on meteorology, kept at Anjarakandy, a place where the trades "shorten up," as the theory tells us. When the trades blow over this place, between 12° and 13° north latitude, the thermometer stands during April at a mean of 85° Fahrenheit—and when the Sun is south. In July, when the Sun is vertical, and the "belt of calms" is over it, the thermometer is 77°. And after, in November, when the trades sweep over it again, and the Sun is south, it is at 80°—a difference of 5° and 8° against the theory.

Next we come to Northern Africa, and with the record of Dr. Barth, at Kukuwa and Soudan—latitude 12° north, when the trades blow the mercury for more than half the days, is above 100°, in April, May and early June, while the Sun is not vertical. In August, when the trade is "shortened up," and does not blow, and when the Sun is vertical, the thermometer only rose above 90° on two days. And after, in October, when the trades returned, and the Sun was not vertical, it rose again to above 100° on every day of the month save two.

According to Dr. Barth, between May and October, when the Sun was not vertical, and July and August when it was vertical, the mean difference in the thermometer was 15° against the theory.

We now come to the North Atlantic, where we have the tables of no less authority than those of Dove. On latitude 14°, the limit of the trades, the temperature for five degrees north of this is always at least two degrees higher. And here the tables of Prof. Coffin, published by the Smithsonian Institute, are also available. These show that for six hundred miles of the African coast, adjoining the great Sahara desert, on which the surface is heated to a daily temperature of 130° to 160°, and where the thermometer stands in the shade during the summer months, as high as 112°, the wind draws off from this heated surface and blows into a region where the mercury is never over 84°—and according to Prof. Coffin's map of the trades, when by the theory the wind should blow from the sea into this heated area, constantly, that in only twelve recorded instances out of three hundred and ninety-four, in the month of August, did the wind blow from any quarter to this hot region or toward the shore anywhere. The hot desert does not draw the winds from the cool ocean, nor does it in the least hold back or disturb the trades which blow over it—but they blow uninterruptedly from land heated to 130° every day on to water which is never heated over 82°.

The next to consider is South America, north of the equator, on the plains of the Orinoco, where we have the testimony of Humboldt, when the trades are blowing over them. These are his words: "When beneath the vertical rays of the bright and cloudless sun of the tropics, the parched sward, crumbles into dust, then the indurated soil cracks and bursts, as if rent asunder by some mighty earthquake. The hot dusty earth forms a cloudy veil, which shrouds the heavens from view, and increase the stifling oppression of the atmosphere, while the east wind (the trades) when it blows over the long heated soil, instead of cooling adds to the burning glow." And all this time to the south of this, this hot wind is blowing into an area far cooler, and where refreshing rains are present.

We have the same evidence from Lieut. Herndon, in his exploration of the Amazon, we find the same facts in the wind charts of Lieut. Maury, and Livingstone bears testimony to the same circumstance south of the equator in southern Africa.

Now, as to collateral or minor testimony—in the land and sea breezes, about which the same popular opinion prevails—that as the land cools at night there is a breeze seaward, because it retains a more equable temperature—but as the sun rises and heats the land the cool breezes come in from the sea. In some places, as on our own Atlantic coast, the winds do blow so, but on other shores they do not—and this difference shows that it is not this assumed law that governs—for a law does not hold good in one or two instances and fail in a half dozen. This is reversing the test that the exception proves the rule, by making it a rule entirely of exceptions. On the coast of north Africa it is not so. In southern Arabia it is not so. It is not so in eastern Africa along the Mozambique coast, from 10° to 20° south latitude, where is some of the hottest land on the globe. The cool breezes of the Indian Ocean do not there blow toward the land, but on the contrary from the furnace hot land into the cool ocean. And it is not so in that part of Hindostan which includes the region between the valley of the Oxus in Persia and the Aral Lake, although the land is heated from 103° to 150° and the atmosphere to 100°; on the contrary the wind blows steadily toward the cool sea—and blows from the north at that. And from Madeira by the Canary Islands, along the coast to Cape Blanco and the Cape de Verd Islands, either calms or dry winds from the desert are generally met with —the harmattan, or land wind of the desert, which is noted for taking the fine dust far out to sea.

All these are facts—of record by the thermometer, and by writers of recognized authority in science. These data alone would swell this paper beyond its limits, and they can only be summarized. But here they are for all the continents.

It is not the present purpose to notice the theory for these phenomena —that belongs to another view of the subject—but they are used to show that the commonly accepted theory of the causes which create the winds and the movements of the atmosphere—the heat derived from the sun by a great uprising vortex at the equator, which causes the cool air to rush in from the poles to restore the equilibrium—does not explain them—because the facts are opposed to it.

We must then revise our ideas of the atmosphere itself. It cannot be the dead fluid, without property or force within itself, that we have been led to think, and only acted on by forces from without. It must have inherent or latent forces within itself, joined with the solid earth by influences acting and re-acting, and constant, to satisfactorily account for all these phenomena. The earth and the atmosphere are no more separate entities than are the solid earth and the fluid water. They are to be viewed as blended in their relations, because all are of a common origin—obeying a common law, controlled and perpetuated by kindred forces—all but the same matter in varying forms.

As facts contradict the theory upon which phenomena of the atmosphere have been accounted for in the past, we must seek hypotheses in harmony with the facts. As experiments have always proceeded upon the old theory, they have been accredited when reconcilable with it, and when not have been set aside as not understood, rather than as needing inquiry because they differed with or could not be combined with the theory.

As an illustration of this it is only necessary to refer to nitrogen, which is disposed of by the simple declaration—"its office is unknown"—when it comprises 76.7 per cent. of the entire volume of air. Our entire knowledge, save here and there a shadow, of life and its manifestations is confined to the part played by oxygen, which is but 23.2 per cent. Can we call it science when this is the extent of our knowledge? Does not reason tell us that life, existing in a fluid ocean, finding no office essential to its development, growth and sustenance from three-fourths of the volume of the element it inhabits—is an unsatisfactory solution?

How came the atmosphere? ought to be our first inquiry. And how is it maintained to perform its uses? should be the next.

The solar sytem is a fact. It obeys the same laws; it is controlled by the same forces; they are the same in all its parts—must be so—because of a common origin and a co-existence. This being so, the conclusion is inevitable that the elements composing it—its matter—are alike in all its parts—differing not in essence but in degree. As its members differ in size, these forces operating to the present, have only produced different states of matter. The entire system must have had a simultaneous origin, for its mechanism has never changed within the knowledge of man, nor has he found evidence that gives color to anything otherwise. Orbits have been eternal. Any difference in conditions must then have arisen from the differing volumes.

We are ignorant of what we call space—its forces, if any, and the influences flowing from it—and are thus confined to what we can discover of the various members of the system—or family of worlds. As the solar system is a unit, its origin the same, its matter identical, its laws uniform—its formation must have been so, and so of its development. One error has been that we take the earth as a globe of matter, and in contrast with the life upon it—dead. Is not this an error at the beginning? If, considering it a living thing, full of pulsating and circulating forces, being acted on and re-acting, do we not start with a clear apprehension of its phenomena? That it is instinct with life, with unceasing and inconceivable forces in constant action reason teaches, and its relations with and obedience to the mighty laws of its planetary family, demonstrate.

In this light let us examine as to the origin of the atmosphere, as the logic of the formative process would suggest.

Taking the nebular hypothesis as true, or its modification, the hypothesis of nebular aggregation—the same for this purpose—and human reason aided by research has failed to find any other answering to what is known —let us follow the formation of worlds. The telescope reveals to us the cosmic cloud, star dust, which in some stage of development, must be of the material of the worlds. The mathematician has demonstrated that planets must be the result of such masses if rotating on their centres—condensing and giving off by the radiation of heat, a portion becomes the ball of matter that we inhabit, at the first a liquid globe, with all its matter in a fused and homogeneous condition. The more active radiation consequent on its separation from the general mass caused a crust to form. And this proceeding indefinitely, the elements most eligible for the operation of this force first becoming solidified, and so through the ages, proceeding by unchanging law. It was impossible in the beginning for life to exist, in any form, for the atmosphere was too intensely heated for its gaseous elements to form compounds, and it must have required ages of this cooling process before even oxygen and hydrogen could unite to form the vapor of water, by which the cooling process was accelerated, from the primeval rains which descended in incessant floods upon the heated mass.

And this intensifying the process, the action and re-action from the force thus evolved elude all conception in their awful power and sublimity —rending the crust and pulverizing rocks. These waters finally collecting into the depressions and basins formed by these throes of the primeval world, the thermal lakes and seas were formed as we find them in still cooler conditions in the age of man.

Still cooling, the elevated lands, seamed and scarred, began to be clothed with matter in new forms, and life in its lowest forms appeared—the facile elements had solidified into the earth, the obdurate remained as the atmosphere.

Thus was the world, as we know it, evolved from the original forms and fitted for the uses to which its author had dedicated it in the beginning.

That this must have been so, let us look out to our neighbors of the solar system and learn of them. We know that the planets possess atmospheres; we know the sun's atmosphere. The spectroscope tells us of what these are composed. The atmosphere of the sun besides what our own has, is composed of what are the solids of our earth, so intensely heated that iron vapor is one of its largest constituents. We, too, had iron in ours. The atmospheres of Venus and Mars appear like our own—for the reason that their size and conditions of mass approximate ours. Jupiter and Saturn have atmospheres so different that it is highly probable these planets possess so high a temperature as to hold many of our solids in a state of vapor, because, from their great mass, the cooling process has not reached the stage it has with us. And from all indications Jupiter is now in the condition described for our earth, in the period of the vapory condensation and rains. The moon shows no atmosphere that is perceptible from our methods—because from her size she must have so cooled as to condense all her matter—that her rocks have absorbed the oxygen and nitrogen, as the process is now going on in the nitre beds of our earth. This is not only possible, but by the law of planetary development must be so, from the properties of the atmosphere itself—for its most prominent physical property is that it is expanded by heat and condensed by cold—the latter if intense enough reducing all things to solids—and then the end. In degree we see this quality before us every day proclaiming the law.

That the atmosphere is the result of this condensation, or rather remains as that portion of the original mass which refuses the solidifying agencies, has support in the nature of the elements themselves. No agent, no resource has yet been found in chemistry powerful enough to change the conditions of pure nitrogen and oxygen. Nitrogen not only resists all efforts to change its form, but to unite it with other substances. It is persistent and unchangeable by any known appliance. Why then may it not be the result, or rather the residuum, of the forces which have transformed our earth from a glowing ball to the beneficent world we find it? And so of oxygen, another obdurate element, a little less so than nitrogen, therefore less in volume, and combining with hydrogen to form water; abundant in all matter, and when subject to the forces of nature, producing a concentrated form of itself, called ozone. Following the cosmic law, accepting the universally received hypothesis of the origin of the solar system, and its formation—can we account for the existence of the atmosphere upon any other theory than this? It seems from the premises logically inevitable.

That it is so analogy teaches—for in excess of either oxygen or nitrogen, life becomes impossible, beyond given quantities. And that the time was when they were in excess, we have abundant evidence, as in the case of nitrogen even, in the saltpetre caves and the vast nitre beds of some parts of the world, in which this stubborn element is imprisoned by a force greater than we know, and the oxygen in its varied combinations. When so reduced in volume, life as it exists was possible, and it came when the place was prepared for it.

If, then, this is the origin of the atmosphere, it suggests another thing. Being a part of the original matter of the earth, differing only in state from inherent properties of its own—being obdurate in the direction of solids while others are facile—it must not only be influenced by the same forces that influence the solid portions of the planet, but it must support its share of the circulating forces which give life and potency to it. And that it is so we gather in many ways.

Besides these two principal elements, we find in the air carbonic acid, ammonia, ozone, vapor of water and traces of other substances which have so far eluded the formulæ of the chemist. The presence of these substances, so easily managed as to make them common objects in the laboratory, demonstrates that they are introduced into the atmosphere, or mixed with it, from the earth. And the life of plants and animals—their processes of life evidence that from the immense quantities thrown off, or utilized, they must be re-absorbed into the circulation of the globe, or life would become extinct by their abundance overcharging the atmosphere with their noxious properties. For we must remember the nature of its chief components is to resist combination—their office is to diffuse, not absorb and change.

Then we come to the other phenomena, which are apparent to the senses only in their ultra manifestations—in storms, clouds, rain, thunder, lightnings. That these are impossible without direct connection, is so patent to the sense that they hardly need extended notice. The cloud discharges itself upon the earth, the earth responds to the cloud, and when intensely excited even earthquakes answer in sympathy, and declare the universal kinship of matter.

That the same currents of circulation pervade both, the response of the magnet to the splendors of the aurora attest, and even man by invoking this kinship can talk from mountain top to mountain top, as has been done, by simply asking the air to bear his messages—showing that the life currents of matter equally pervade the atmosphere with the more palpable elements of the solid globe.

That there is this intimate and constant relation between the earth and air—an absorption and emanation, so to speak—is better illustrated by the elements forming the smaller components of the atmosphere. And why should it not be so, when before our senses every day is shown that beyond all absorbents and disinfectants is mother earth, and beyond all diffusant mediums is the sustaining air. Take for example carbonic acid. If the supply is too small, life languishes, if over-abundant, death intervenes. That the supply is not everywhere and at all times the same, we see in the conditions of health in cities, and in marshy districts, and at certain periods; in the sometimes rank display of vegetation, and in places where no plant can live from its excess. It is exhaled into the air by animal respiration, by combustion of fuel, from decay of organic matter, from volcanoes, from thermal waters. It goes back through the leaves and by the roots of plants—but this is only one of the methods—it is stored in the coal measures, and the peat beds show that the process of storing it beyond the normal wants of life is keeping pace with the ages. That the atmosphere contained once immensely more than now, the saurian age, when only cold blooded animals could live on the earth, attests. Restore the carbonic acid of that period, and mammal life would become at once extinct.

Next is the vapor of water—its nature proclaims it an emanation and in constant flow from the earth. Then, we find ammonia, so intensely diffusive, and so strong in affinity for other substances, that its presence in the rain, the snow and the dews, tells us at once how it is maintained in its proportion in the air we breathe. And now we find ozone, which perhaps of all the elements best illustrates the circulation of the earth and air. It is believed to be but a condensed or concentrated form of oxygen itself, compelled by a laboratory more powerful than any of man, and which has its seat in the earth. And it is the best illustration, because: (1) It is more abundant in the country than in cities and towns; (2) Its quantity is greatest in spring, less in the summer, decreasing in autumn, and least in winter. (3) It is most readily detected on rainy days, or after any great atmospheric disturbance.

Do not these facts point unvaryingly to the mutual action between the earth and atmosphere? Ozone is most abundant in the country, because the exhalation in cities is interrupted by houses, pavements and hard beaten surfaces. It is most abundant in spring, when the pores of the earth have been left open by the retiring frost, and it decreases in summer and autumn as these conditions become less, and least in winter when the whole face of the earth approximates the condition of cities. And it is more largely present after great atmospheric disturbances, because it is then that the effort of nature to restore the disturbed equilibrium is most active.

And lastly, we have the phenomena of epidemic disease, which is only to be explained by atmospheric causes—which are not carried by winds alone, because often traveling in the teeth of winds, and crossing continents in the very face of the trades, and on contrary sides of the globe, maintaining their same unvarying features.

That greater quantities of nitrogen, that element of the unknown office, than even now, once filled the air is evident, as well as that carbonic acid was once in greater volume—as the nitre beds referred to attest. Because we cannot with our glass retorts and furnaces harness this obdurate element, is no reason to conclude that the power which holds the solar system in its grasp, and which in the laboratory of the Sun evolves its iron into air, which sends vast globes in eternal rounds, with velocities that baffle imagination, yet holds them with the rein of mathematical obedience—that it is not equal to the task. Why stand we in awe of the giant power of nitrogen when imprisoned in its cruder forms of gunpowder and its kindred explosives, as it shakes the solid earth? and refuse to hear it when struck by the power of this occult force in midheaven, speaking to us in the voice of thunder, or when touched by the same power in the caverns of the earth admonishes us of its pervasive presence in all nature through the throes of the earthquake—upheaving mountains and depressing great areas of solid land.

Is it not as patent that these forces are from a common agent, as it is that the lava streaming out is glowing because of the presence of its twin element, oxygen?

If we will only accept this as probable, how much more rational becomes the solution of all these phenomena, than by the far fetched theory.

so palpably contradicted, that the earth is inert, that the atmosphere is a passive fluid—the one a stranger to the other—and all these wondrous exhibitions of kindred forces but the result of the Sun's rays, acting extraneously and without sympathy from elemental power, inhering in all parts and members of the solar system. That it must be so reason tells—facts demonstrate it—it cannot be otherwise. The earth is but a member of a common family—the atmosphere born of the same matter, obedient to the same law, controlled by the same force common to all—that force pervading every part of both—not solely induced by external heat. What is it?

This force, we arbitrarily call electricity. So far as human knowledge can take cognizance, it is that which pervades all matter, from the molecule to the planet, and binds all together. The trouble is that we reason from what strikes the natural senses, back to phenomena—we cannot eat or drink the air or the elements, hence we fail to realize them. But if we reason from them up to, or down to their ultimates, that we do use as ministers to our life, and life in all its manifestations, we become results, instead of their assuming the fragmentary form of phenomena of which our senses take cognizance. Science, from this stand-point enlarges our vision and adds to the capabilities of sense.

We now know that we must revise our theories—that the life of our world is only one form of the manifestation of matter and force—that behind it is a force or life more potent, of which it was born and by which it is controlled and maintained. That this force is what we call electricity there is no doubting—it is present in the atom and in the Sun, constant and the same—the life of worlds and of all divisions, elements and combinations of matter. That this force on the earth is excited and influenced by the heat of the Sun or through it upon other less intense forms of matter is beyond question. And now let us see if this is not the path to the secret of atmospheric phenomena?

Electricity, if not heat, is associated with it; if not light, it is with light in its operation—for it manifests both intense heat and light. If it is not in itself the law of chemical affinity, it is present with and controls it. If not magnetism, it is one of its modes of operation. If it is not gravity, it is always in its company. And if not itself the vital force of all nature and of vegetable and animal life, it is certainly coincident with and capable of controlling all. Briefly, as far as we know, it is the soul of matter, and its expressions are what we call its phenomena—whether in those limited to the field of our own earth or cosmical in their action.

The earth is a magnet, but not a natural one—but all bodies can be magnetized by currents of electricity flowing round them. We also know that the electricity of any body is excited and made to flow in currents by various causes:—by the disturbance of chemical affinity; by the decomposition of composite bodies; by the molestation of crystallized lamina, and also by the unequal heating of them—the electricity being excited in the heated part and flowing to the colder. And what now?

The earth is ever heated in part, ever cooling in part. The Sun is constantly shining on some portion of the globe, while another portion is continually in shadow. That portion on which the Sun shines at midday is warmer than that portion covered by mignight darkness—sometimes not less than sixty degrees difference. By the well known law of thermal electricity currents must be excited where the surface is heated and flow to where it is cooler—and thus we have currents always flowing from east to west—from where it is day to where it is night—for to the Sun the west is night. And by this current ever in flow, the earth becomes a magnet. This must be, but how far the magnetic ray of the Sun itself assists, is unknown—we only do know that the violet ray of the spectrum will render a needle magnetic.

Then again, constant parallel currents of electricity tend to converge, and thus produce intense action, and again they tend to produce secondary currents, and so on successively. By this method lateral currents are produced in or over the earth, as discovered by Faraday. These currents sometimes become so intense as to produce what Humboldt calls magnetic storms, from which comes the Aurora—so powerful at times that the telegraph can be worked without the aid of batteries.

All currents of electricity passing through the air, tend to displace it, and to create currents in it. Here are the inducing causes of the winds, varying according to electrical activity, from the breeze that gratifies to the tornado that is carried forward with such amazing velocity and such terrible power. That it flows from the earth to the air conducted by the same properties of matter, can be even seen at times by the naked eye—from trees, from mountains and every object that elevates itself above the common level of the mass of the earth—as well as on the sea from the masts of ships.

The discoveries of Meissner and Faraday, as to the magnetization of oxygen, leave no further doubt that evaporation is to a great extent an electric process, aided by heat, but acting independent of it. Dr. Kane tells of thaws in the arctic regions during the long polar nights, when no ray of Sun had visited them for weeks. And Captain Hall, on the farthest point ever reached by explorer toward the pole, was gladdened by the far northern horizon banked with nimbus clouds. This vapor when evaporated is combined with the oxygen and electricity, and exists by that force in the atmosphere. This acted upon, by static or inductive forces, perhaps, condenses, and clouds are the result. It takes place, we see, as readily in the depths of the arctic night as in the heated atmosphere of the tropical day. And the artic storm, which by this vaunted law, should be the result of heat, by its icy breath destroys even lichen life and howls in those awful solitudes, amid crashing icebergs and the groaning ice fields with a power that surpasses the storm revels of the tropics.

Dynamically, the heat of the Sun is incompetent to this task even under the most favorable conditions. I must return to this theory once more, to give it a parting word. Its advocates tell us all these awful manifestations come from the ascensive power of heated air, but experiment has demonstrated that even air, confined so as to prevent the operation of the law of diffusion and expansion, which are free to act in the atmosphere, where heated to 100° above surrounding air, exerts a force of only one-third of an ounce to a square foot. Yet forests have been prostrated, cities wrecked, and navies stranded when the thermometer showed but 70°. Is it possible science has endorsed such a stupendous illusion as this? Why not instead look to this other source for the daily atmospheric phenomena, all over the globe? The electrical current is uniform, the heated air theory is not—the results, varied and incessant, are in harmony with the electric law, which is constant but in varying intensity. The one is harmonious and consistent, the other uniform only in its inconsistencies. Every day we see the evidences of the electric flow—even the shivered tree tells its story that the positive cloud and the negative earth have established the electrical equilibrium, leaving it to be a witness that man may learn. We are told the same fact by influences upon animal life long before the disturbing cause has become patent to the sense. Cackling geese saved Rome, but their cries preceding a storm have told the rustic for ages what science has shut its eyes to for centuries. Even the unpoetic pig has discovered the fact, and in obedience to the law makes his bed warm long in advance. Can we not learn of facts as well?—that these are the warnings of electrical conditions, not of tropical heats 2,000 miles to the south of us.

But to return. Even the oscillations of the barometer are now found to be influenced by electric currents, for it has its maxima and its minima, entirely independent of temperature—tides of the atmosphere as there are tides of the sea—induced by electric tension of the air. And as intimated before, it is more than a question whether clouds themselves are not the result of electric process instead of cold—or that cold is only one of its agents, but not indispensable.

It is by no means settled that magnetism does not promote cold, and that in this form of electricity we may not find the factor which has always been evoked from unknown and unknowable space. If so, then the circle is complete That "cold is the absence of heat," has been the extent of our knowledge, is proverbial, but if cold, too, is found to be but one form of the manifestation of this mysterious force, then will meteorology gain new elements for the fulfillment of its ambition as an exact science.

We do know that the magnetic intensity of the earth differs—it is not uniformly distributed. There are magnetic poles, and we find that there are lines of greatest intensity, passing from these poles and connecting with like poles in both hemispheres. They are known as lines of no variation—or where the needle does not dip. Facts show that these lines affect the meteorology of that portion of the earth through which they pass—as the stormy Atlantic and the peaceful Pacific seas attest, as well as the climatic conditions of their coasts.

But the important fact is that these magnetic poles are poles of cold. All the isothermal lines of our hemisphere are affected by these poles, or area of no variation and greatest intensity. Take a globe, with the isothermal lines drawn upon it, and looking down from above the north pole, and this fact strikes the observer with startling force. That seas and elevations have their effect upon these lines of temperature, is undoubted, but that they are intimately connected with the magnetism of the earth, or that its temperature is affected by these poles, is too apparent to be rejected.

But this topic can be followed no farther—for a paper of this scope must have a limit—it, however, indicates the way for the completion of the law.

In this vast field, it was necessary to be discursive, and that is the view presented. I have not pretended to have a theory, or to account for the phenomena of the atmosphere. That much of what has been said is of course crude and undigested, is too true. The only object has been to set forth some facts, which have from time to time forced upon the mind the conviction that the old and generally accepted theory of the atmosphere and its phenomena was not the true one. That at best it was but a partial presentation of the causes underlying these phenomena—and as a law utterly without the authority of facts to sustain it, and that we must look elsewhere for light, which after nearly two centuries of following this theory has ended in deeper darkness.

If, then, the solar system had a common origin—which the common law it obeys declares—its matter is the same; that its constitution as to its members varies only in degree; that the law of the atom is but the law of a world, and the force that travels with the sun, the same that abides with the sun itself, and in all its family of worlds. That life is the law of matter, and that the planets have their life, as we that live on them have ours—that one is the result of the same law, or power, as we may call it, as the other,—the one world differing from the other only in degree.

That if the solar system was the result of force, acting on nebulous matter, our atmosphere is as much a part of that nebulous matter as the rocks—that both are the result of the same force which we call radiation, or cooling—and that it is composed, mainly, of those elements immutable to the forces that formed the solid globe or liquid waters. That at a period in this process, life as we know it was impossible, and that life came when the conditions made it possible. That the process is still going on, or, that the forces which once operated on the primal nebula have in the long ages of their operation produced such an equilibrium of matter, so adjusted its functions as to make the elements as a whole, self compensating, self-conserving, and thus self-perpetuating and eternal—for the purposes of this paper not requisite to know or to inquire.

That the air and earth, thus of the same origin, are for planetary purposes identical, and controlled by forces which impart the properties or influences of the one to the other. That the atmosphere supports life—at the bottom of the seas as in the air itself. That it not only surrounds the earth, but permeates it, imparting life and drawing life to itself, and that the influence evolved in the one is felt in the other, and that both reach out to their sister elements in the great family of the solar system.

This being so, the phenomena we see—of heat, cold, clouds, rain, calm and storm, the winds and the tornado, all flow from the manifestations of the life of the system itself—the revelations of the life currents of earth, whose results we see in them, and whence we know they exist—but which itself we cannot know, or have been unable as yet to discover or fully understand.

That the heat of the sun is a powerful factor in all this life, admits of no doubt, but that this globe has within it energies of its own, we may say latent heat of its own, which acts responsive, is beyond the power of mind or intelligence to doubt.

METEORIC STONES AND SHOOTING STARS.

BY PROF. G. C. BROADHEAD, PLEASANT HILL, MO.

The phenomenon of Falling Stars or Meteoric Showers, and Aerolites or Meteoric Stones and Bolides, is one that is least understood of celestial phenomena, yet one that is near us and at all times interesting to the scientist. They flash before our vision with dazzling brilliancy, apparently burst and disappear. Some are gaseous and of course transparent, others are solid, as the Bolides.

Meteoric Stones are liable to fall at any time, but at certain periods of time shooting stars are more likely to be seen. Every year about the 10th of August, a shower of meteors is seen that appears to proceed from the constellation Perseus. Another period of the 12th and 13th days of November, after thirty-three years, and for three years thereafter, at which time they apparently proceed from the Constellation Leo. The next periodic appearance of the November shower will be in the year 1900.

Besides these two principal showers, it is estimated that there are nearly one hundred others recurring at regular intervals, and each a cosmical cloud of dark bodies, loosely held together and circulating around the Sun in a common orbit*

Schiapparelli, Le Verrier and others, give as their conclusions, that meteors are fragmentary masses revolving like the planets round the Sun in a regular orbit, which, in its course, approaches the orbit of the Earth, which is intersected by their orbit at this regular period, and are drawn by its attraction into our atmosphere, and are there set set on fire by heat generated by the resistance offered by the compressed air.

Schiapparelli also came to the conclusion that the same object at one

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* Schellen.

time may be a comet, and at another time a shower of meteors. He first observed that a large and brilliant comet which appeared in 1862, crossed the path of the Earth's orbit in the very region in which the August meteors appeared. His investigations proved that both the comet and the meteors had traveled along the same path. But with much study and observation it was some time before an attendant on the November train could be found. At last Peters found that a telescopic comet did in fact travel the same path as that of the November meteors. These facts at least showed that close relations existed between comets and meteors, and caused astronomers to study more closely.

Adams demonstrated that the zone of cosmical bodies forming the meteor system, had an orbit extending out into space beyond the orbit of Uranus, and the opinion of some astronomers is, that to Uranus do we owe the attraction of these star showers.

The various meteor systems appear to proceed from or near some fixed point in the heavens. Besides the radiant points above named, there is a prominent shower of November 27, that appears to proceed from (*Gamma*) Andromedæ.

Meteors chiefly appear between 46 and 92 miles elevation, (mean, 66), their speed varying from fourteen to one hundred and seven miles per second. A majority of the November meteors seen in 1868, appeared of an orange color, a very few blue.

In 1866 the portion of the stream of November meteors through which the Earth passed, was 80,000 miles deep. In 1867, the Earth traversed a shallow part of the stream, or 50,000 miles.* Prof. H. A. Newton estimates the thickness of the August ring at five to ten millions of miles; for the Earth moving at the rate of two millions of miles per day, is immersed in it for several days, and in two hundred and eighty-one days, periodic time, he estimates more than 300,000,000,000,000 for the total number in the August ring.† Prof. Twining (‡) says: "The conformable meteors of November and August are chiefly to be distinguished from ordinary shooting stars by a massive aspect resulting from a more ardent and copious combustion. They are further distinguished by their numbers and relations to a radiant. Those of ordinary nights also sometimes pursue an erratic course, darting off laterally at the end of their appearance, or waving from side to side, sometimes even appearing to expire twice.

THE NOVEMBER SHOWER.

Humboldt gives the following catalogue of the appearances of the November 13th shower:

1787............	November	9-10	1846............	November	12–13
1818............	"	12–13	1847............	"	12–13
1822............	"	12	1849............	"	12–13
1823............	"	12–13			

* Eclectic Monthly, February, 1870.
† American Journal of Science. ‡ American Journal of Science, January, 1863.

A star shower is chronicled in Germany as appearing November 15th, 1606, seeming as if it rained stars, first the largest and brightest, and then both large and small ones, becoming extinguished before reaching the Earth†

An early record was that of a meteoric storm A. D. 902. Later one of November 9, 1698; of November, 1833, and November 14, 1866. From these data it was at once known that the period of the November shower was thirty-three years.

Other displays referred to the November shower were:

October	18.5	A. D.	903	October	29.5	A. D.	1366
"	19	"	931	Novem'r	3	"	1533
"	19	"	934	"	8.6	"	1698
"	20	"	1002	"	11.6	"	1799
"	24	"	1101	"	12.7	"	1833
"	26	"	1202				

Arago estimated that during three hours of the 12th of November, 1833, there passed over 240,000 meteors. Many persons can now remember that it was a very remarkable shower. So remarkable was it in its brilliancy and number of stars, as to be a source of terror to many of the ignorant, who imagined the final day of all things had arrived.

It has been assumed by astronomers, based on observations made, that seven and a half millions of meteors pass the Earth's atmosphere, and bright enough to be seen by the naked eye, every twenty-four hours; or, if revealed by the telescope, would number four hundred millions.‡

METEORS OF NOVEMBER 27.

At Teneriffe, Canary Islands, on the 27th of November, 1872, five hundred meteors were seen to fall in the space of half an hour. At 11:30 P. M., November 29, the rooms of the American Consul, Mr. O. F. Dabney, were suddenly illuminated by an intense blueish white light, lasting for several seconds. It was apparently brighter than the moonlight, becoming red, and then vanishing. About four minutes after a report was heard similar to that of a large piece of artillery, shaking the house and reverberating for some seconds among the surrounding mountains. Persons saw this meteor as a luminous body of conical shape, going with great velocity, point foremost, and drawing after it a long fiery train.*

The above-named shower of the 27th, was also observed under very favorable circumstances, by Padre Denza, at Moncalieri, Italy. It was apparent from dusk until after midnight, during which time of six hours, 33,400 meteors were counted by four observers. But this really did not include the total number passing, for in the first hour of the night, and especially in the hour of the maximum fall, 8 o'clock, there was in some regions of the heavens truly a rain of fire, so that it was impossible to count any but the most remarkable. Padre Denza speaks of this as a very won-

† American Journal of Science, September, 1863.
‡ Schellen in Half Hour Recreations.
* American Journal of Science, August, 1873.

derful and beautiful phenomenon, some meteors showing the most varied and delicate colors; many were followed by broad and brilliant tracks of fire, very frequently balls of a dazzling white, and with a diameter but little less than that of the moon, were seen. The general aspect was that of a cosmical cloud, which, encountering our atmosphere, was broken in pieces and scattered. The position of the radiant was near (*Gamma*) Andromedæ.

Denza considered it a regular periodic shower, the same seen by Brandes 7th December, 1798, by Abbe Raillard December 7, 1830, by Herrick and Flangorgues in 1838, also recognized at Bergamo in 1867. In 1872 its point of contact with the earth's orbit should fall on November 27–28.

This shower of November 27, 1872, was also seen at Turin, at Rome, at Palermo, at Naples, at Messina. At Matera, Prof. Vito Eugenio with three assistants counted 38,153 meteors in six hours. The maximum took place everywhere between 8 and 9 o'clock, and the radiant was found to be not far from (*gamma*) Andromedæ.

This display was observed in Egypt and well noted in England. E. J. Lowe, of Nottingham, enumerated 58,660 between 5 h 20′ p. m. and 10 h 30′ p. m., and observed the radiant point to be (*gamma*) Andromedæ. Near the radiant point the meteors were the smallest and had the shortest paths. All had tails, but only the largest were observed to vary in color. Several times during the display reports were heard, resembling that of distant shot guns.

At Athens, Greece, about 25,000 were counted during nine hours, and Dr. Schmidt stated, that while the shower of November 13, 1866, was remarkable for its brilliancy, its numerous bolides, the slenderness and brightness of the trains and preponderance of green colors, that of November 27, 1872, was entirely different, the stars were chiefly faint with broad smokelike trains and colors between white and reddish yellow, and motion apparently slow and undecided. †

This shower of November 27th was also observed at numerous stations in the United States, beginning on the 24th, but there were not so many counted. Their point of radiance was from (*gamma*) Andromedæ.

Old Lusatian chronicles report that on 3d December, 1565, there fell at Soran fire from heaven like flakes of snow. ‡

Prof. Newton‖ supposes that the meteoric showers were at one time all connected with periodic comets and the scattering took place at or near their perihelion. A startling telegram from Prof. Klinkerfues on the night of November 30th, 1872, ran thus: Biela touched the earth on the 27th. Astronomers state that in 1872 Biela's comet disintegrated and appeared as a star shower. Prof. Newton§ gives data showing that the November star shower has a motion along the siderial year of one day in seventy years, and the dates of the earlier showers show that the true period does not widely differ from the siderial year.

† American Journal, February, 1873.
‡ American Journal, May, 1863. ‖ American Journal, January, 1873. § American Journal. July and September, 1863.

OTHER PERIODS.

Schiapparelli cites a shower whose point of radiance is in the Northern Crown, and time April 30th to May 1st. Prof. Daniel Kirkwood has determined the period of this display to be about seven years, and thinks that it corresponds with the following list of displays:

April 9	A. D. 401	April 17	A. D. 927
" 17	" 538	" 18	" 934
" 17	" 839	" 16	" 1009*

August Meteors.—Francis Bradley in going from Davenport, Iowa, to Chicago, Ill., August 9 and 10, 1858, observed 128 shooting stars, whose radiant point was at or near Perseus. †

Prof. Twining observed at New Haven, Conn., August 10, 1861, at 11½ p. m., a meteor beginning near (*Epsilon*) Cygni, which appeared very brilliant for 12 seconds. Mr. Herrick says, we were startled by a brilliant flash, immediately followed by a bright phosphoric bar, the meteor having suddenly vanished, which was visible for 20 seconds, thus indicating a visible track of 33 miles and altitude of 70 and 54 miles, with a velocity of 26.6 miles per second.‡

On 10th December, 1862, at 10½ to 11 p. m., a half dozen meteors were seen at Philadelphia, apparently radiating from Castor and Pollux. The next morning, from 4 to 4½ a. m., a few more were seen also, all radiating from the same point.

METEORIC STONES.

We have thus far been speaking of Meteorites as bodies having some definite motion. Bolides or Aerolites are reckoned by some persons to be governed by the same laws and to have periodic revolutions, but others, and even our best scientific men, choose to think differently. Investigations prove that the laws of crystalization affecting them are the same as those affecting terrestial matter. || Thus we find pyroxene, olivine, chrome iron, angite, &c., as constituents of meteoric bodies. Their form is very irregular and of various shapes, going to prove that the individual meteorites have not always been cosmical bodies, for otherwise their form would have been spherical or spheroidal. They must, therefore, at one time, have formed part of a larger mass.

Sulphurets and phosphurets of metals are also found in the interior of the mass, arranged in nodules completely separated from the mass. ||

Meteoric stones may be (1) metallic, (2) stony, (3) mixed. The rocks or minerals of meteorites are not of a sedimentary character, nor such as are produced by the action or agency of water. The stony meteorites all have a dark colored coating, which has been formed upon them after they entered our atmosphere. Metallic iron alloyed with more or less nickel and cobalt is of almost constant occurrence in meteorites. The existence of this highly oxydizable mineral in its metallic condition is a positive indication

* American Journal, July, 1872. † American Journal, November, 1858.
‡ American Journal, November, 1861.
|| Dr. J. L. Smith, Scientific Researches, p. 285

of a scarcity or total absence of oxygen (in its gaseous state or in the form of water) in the locality whence it came. The stony portions resemble the older igneous rocks, and very closely those of some active or extinct volcanoes. Phosphorus is frequently but not always associated with the iron. † Iron, nickel, cobalt and phosphorus are almost constant constituents, and Dr. J. Lawrence Smith states that in only three or four, out of some hundreds, they were not recognized; and none of these minerals are associated with oxygen; and excepting copper, none of them are even found upon the earth without oxygen. Phosphorus is probably always an associate of meteoric irons.

Although analysis reveals that meteorites do contain a few minerals unknown to our earth, still these minerals may be resolved into their simple elements such as we are familiar with. Besides the above constituents they contain oxygen, hydrogen, sulphur, phosphorus, carbon, aluminium, titanium, lead, manganese, calcium, sodium, potassium, magnesium, lithium, strontium; also olivine, augite, tin, and chromium.

Dr. J. Lawrence Smith considers that enstatite, bronzite and chrysolite form 90 per cent of the earthy minerals in the aggregate mass of all meteoric stones. ‡

Schreibersite and Troillite, two minerals not found in the earth, are found in meteorites. Schreibersite is a phosphuret of iron and nickel, with traces of copper and cobalt. Troillite is a protosulphid of iron, with sometimes traces of nickel and copper.

Some scientific persons proclaim the theory that solid meteors have been ejected from the moon, others that they are formed from particles collected in the atmosphere. The theory of others, is that they are small planetary bodies revolving around the sun, one portion of their orbit approaching or crossing that of the earth, and, being small bodies, approach too near our planet and fall to the earth's surface. This presupposes their having always had an individual cosmical existence.

Terzego in 1660 and Olbers in 1795 advanced the lunar theory, which was supported by Laplace up to his death. Berzelius, Arago and others also held the same views, but in 1836 Olbers discarded it and adopted the cosmical theory.

The average specific gravity of meteors is claimed to be about the same as that of the moon, as also their chemical composition. Astronomers say that a body projected from the moon with a velocity of about 8,000 feet per second would go beyond the mutual point of attraction between the earth and moon. Dr. Peters, who made observations at Mount Ætna, estimated that the velocity of some stones was 1250 feet per second, and observations at Teneriffe gave 3,000 feet per second. *

WIDMANSTATTIAN FIGURES.

There are certain lines resembling scratches, developed on the smooth

† Scientific Researches, J. L. Jmith, p. 287, 288. ‡ Scientific Researches, p. 376.
* Scientific Researches by J. Lawrence Smith.

surface of iron meteorites peculiar to them, and thus far never found on any other stone or metal. They are called Widmanstattian figures. In the Bates County, Missouri, meteorite they consist of four systems of lines, those in each system parallel to each other, and crossing those of the other systems at obliques angles. To obtain these lines it is necessary to thoroughly polish the surface of iron, then lay on nitric acid, rub this off and the lines appear. (See p. 741.)

SIZE OF METEORITES.

The Bates County Iron meteorite was a little over 85 lbs. before being cut. The Tazewell, East Tennesse Iron meteorite was 55 lbs. That of iron from Coahuila, Mexico, fifty miles northwest of Santa Rosa, and now in the Smithsonian, 252 lbs. Tucson, Arizona, of iron, 1400 lbs. Eight others from Coahuila, obtained by Dr. Butcher, from 290 to 800 lbs. A mass of meteoric iron now in Chihuahua, weighs about 3,853 lbs. Probably the largest known meteoric mass is of iron, and discovered by Dr. John Evans, in Oregon, in the mountains east of Port Orford, and supposed to weigh several tons.

The San Gregario, Chihuahua, meteorite weighs 1006 lbs. A mass of meteoric iron near Melbourne, Australia, is said to weigh five to six tons; another mass near by weighs one and a half tons. The Gibbs meteorite in the Yale College cabinet, weighs 1635 lbs. It was brought from Red River. Don Rubin de Celis discovered one in the District of Chaco-Gualamba. South America, whose weight was estimated at 32,000 lbs. There is another at Bahia, Brazil, whose weight is 14,000 lbs. The Siberian meteorite found by Pallas, weighed originally 1,600 lbs., and contained embedded crystals of Chrysolite.*

A mass of meteoric iron from Greenland, weighing several thousand pounds, was on exhibition at the Centennial. A Swedish Scientific Expedition to Greenland, in 1871, brought away twenty large pieces of meteoric iron. The largest, of 21 tons, was deposited in the Royal Academy, Stockholm; the next, of nine tons, at Copenhagen.

CATALOGUES OF METEORITES.

Dr. Otto Buchner, Leipzig, 1863, catalogues the fall of 153 stony meteorites, commencing with a fall of Nov. 16, 1492, and ending Oct., 1862.

The various cabinets of the world included in 1863, the following:

Vienna	194	Gottingen	125
London, (British Museum)	190	Paris, (Garden of Plants)	53

The largest private collections:

R. P. Gregg, Manchester, England	191
Reichenbach, Vienna	176
Neville, London	101
Auerbach, Moscow	76
Newman, Prague	61
J. Lawrence Smith, Louisville, Kentucky	60
C, U. Shepard, Amherst College	151†

* Dana Mineralogy, p. 16. † Amerian Journal of Science, November, 1863.

In 1876 Prof. J. Lawrence Smith had 171 in his collection, and in 1872, C. U. Shepard had 143 stony and 93 Iron Meteorites.

REMARKABLE FALLS.

A meteor, or rather a small group of meteors, were observed at New Haven, Conn., at 6 P. M., February 14, 1873. They appeared near Venus, moving northward and downward. There were two balls, the leading, smaller one, bright green, the following one a yellowish color. At New Britain, Conn., it was seen to divide into two portions, and one or two smaller ones; the latter soon vanished, the other two passed on.‡

Dr. Schmidt, at Athens, Greece, October 18, 1863, saw what appeared to the naked eye, a single meteor, but the telescope revealed two large meteors, traveling in front of a number of small fire balls, each of which was followed by a train. Dr. Reinsun observed by means of a telescope, three small meteors, separated frem each other by small dark spaces; the two in front smaller than the third, and the three presented the appearance of a small isosceles triangle, with base in front.

A brilliant fire ball was seen at Montpelier, Vermont, July 17, 1818, between 9 and 10 o'clock P. M. It was a pear-shaped ball the size of the full Moon, with its broader end towards the Earth, and immediately followed by two smaller fire balls.

On June 14, 1871, R. H. Thurston, U. S. N., saw on the deck of a vessel between Providence and New York, a sudden flash of bright blue light, instantaneously succeeded by an equally intense red flash, which again gave place to a blue. A nucleus appeared with a long hair-like train of a bluish color, becoming red on the south side; it disappeared 21° above the horizon.*

A meteor was seen throughout Germany, from Halle to Vienna, three hundred miles distant, at 7 o'clock P. M., December 3, 1861. The length of its path was eighty eight miles; time of flight, two to five seconds, and was about three hundred miles elevation when first seen, and exploded at an elevation of fifty-seven miles, into three pieces. Its diameter was about nine hundred feet, and brilliancy equal to that of the full Moon, increasing to three times that at Vienna.

A meteoric stone weighing 12 lbs., was seen to fall in Hungary at 3 P.M., October 13, 1852, which buried itself in the ground two feet. Near Batsura, India, on May 12, 1861, a sound was heard resembling a cannon, succeeded by several successive peals of seeming thunder. The noise was heard for sixty miles. Five stones were picked up at various places, about three miles apart, one of them having buried itself in the ground about eighteen inches.†

At 9:30 A. M., November 15, 1859, a meteorite fell with a tremendous explosion in the southern part of New Jersey. It was seen from Newburyport, Massachusetts, to Petersburg, Virginia. Its apparent diameter

‡ American Journal of Science, April, 1873.
* American Journal of Science, January, 1871.
† American Journal of Science, July, 18 3.

appeared to be somewhat less than that of the Sun. At New Haven it appeared about 12° high or thirty-six miles; in New York, 35°; at Alexandria, D. C., 40°; disappearing near Tuckertown, N. J., at 10° elevation. Its visible path was estimated to be 15° to 25°, and velocity eighteen to thirty-six miles per second, being visible two seconds at Alexandria. Its disappearance was attended with a sudden flash of light, leaving a smoky column, which soon vanished. A minute after the flash, a series of terrific explosions was heard, which were compared to the discharge of a one thousand pound cannon; this continuing for about two minutes.

Meteor of July 20, 1860.—This was visible for at least a thousand miles in length from N. N. W. to S. S. E. by seven or eight hundred in width; or from Lake Michigan to the Gulf stream and from Maine to Virginia. Observations at New Haven determined its path S. 28° W. with a maximum altitude of 53° and time of flight 10 to 20 seconds. At Meadville, Pa., its altitude was 39° 30′ from the northern horizon, disappearing at an altitude 3° 30′. From the various observations it was determined that the vertical plane in which the meteor moved cuts the earth's surface in a line crossing the northern part of Lake Michigan, passing through Buffalo, Elmira and Sing Sing, N. Y. Greenwich, Conn., and across Long Island into the Atlantic. Its nearest approach to the earth, 41 miles, was a little south of Rhode Island, 44 miles over Hudson river, 51 at Elmira, 62 at Buffalo, 85 over Lake Huron, 120 over Lake Michigan.

It was first seen as a single body, gradually increasing in brilliancy, throwing off occasional sparks and flashes of light. Reaching Elmira an explosion occurred, the meteor separating into two principal portions and other subordinate fragments, but continuing on their course in a line behind each other, but continuing to scatter luminous sparks, until reaching a point south of Nantucket when a second explosion occurred, the principal fragments passing on.

The entire velocity was estimated to be from 8 to 15 miles per second. Probably 12 to 13 miles would be nearly correct. And allowing for the earth's motion in its orbit would give 26 to 27 miles per second as the actual velocity of the meteor in space. The apparent diameter of the luminous mass was nearly that of the moon, and its actual diameter from one fifth to one third of a mile. †

Meteor of August 2, 1860.—Prof. Newton in *American Journal* of May, 1862, gives an interesting account of the appearance of a meteoric fire ball which first became visible over N. E. Georgia near N. lat. 33° 50′ W. long. 82° 40′, at about 82 miles elevation above the earth's surface; passing N. 35° W. for 240 miles, when it exploded at an altitude of 28 miles over the southern boundary of Kentucky, nearly over N. lat. 36° 40′, W. long. 85° 05′. It was seen from Pittsburgh to New Orleans and from Charleston to St. Louis, an area of 900 miles extent. It was seen in West Virginia, at Marietta, O., Cincinnati O., Bloomington, Ind., St. Louis, Mo., Bowling Green, Ky., Nashville, Tenn., Montgomery, Ala., Holly Springs, Miss., Charleston, S. C. The duration of flight 'was variously estimated from 6 seconds to 30 seconds, but was more probably 7 or 8 seconds, for the whole line, which would be from 30 to 35 miles per second. Explosions were heard echoing like thunder from 3 to 5 minutes after at Knoxville, Rome and Pitts' Cross Roads, Tenn.

Some accounts make the apparent size of the meteor larger than that of the moon. Visible explosions were observed during its flight, during which multitudes of sparks were thrown off. In connection with this Prof. Newton considers that those meteors whose velocities are relatively great are burnt up or dissipated before reaching the ground; those whose velocities are slow furnish aerolites.

Meteor of August 6, 1860.—At 7 h 38′ New York mean time, a fire ball about as brilliant as Venus was visible from Pittsburgh, Pa., to Roxbury, Mass. Near the middle of its course it appeared to distant observers to separate into two parts, while those who were nearer saw it continually giving off fragments. Its time of flight was about 6 seconds, and velocity about 14 miles per second.

It first appeared 39 miles above the earth, nearly over the southern line of Pennsylvania, in N. lat. 39° 35′, W. long. 76° 45′, and passing N. 80° W. to a point 36 miles above the earth and west of Buffalo where it was last seen. The total length of its path was 250 miles. ||

Dr. J. Lawrence Smith, in his scientific researches, speaks of a meteorite that was seen to fall two miles west of Petersburgh, Lincoln county, Tenn., at 3:30 P. M., August 5, 1865, during or just after a severe rain storm. It apparently came from the east, and while falling, appeared to be surrounded by a milky halo. Its fall was preceded by a loud report, resembling that of a large cannon, followed by four or five lesser reports. It was buried eighteen inches in the ground, and was of small size, only fourteen and a half ounces, of an ashy-gray color, varied by patches of white, yellowish and dark minerals, and incrusted with a black shiny coat. It was magnetic, with a specific gravity of 3.20. It contained Pyroxene, Olivine, and Orthoclase, disseminated. Nickeliferous iron formed half per cent. of the mass, and nickel a very small quantity.

Several meteorites of similar appearance were seen to fall at Danville, Ala., at 5 P. M., November 27, 1868. A piece weighing four and a half pounds was buried one and a half feet deep in the ground. It contained three per cent, of iron, with a very small per cent. of nickel and cobalt, and had a somewhat oolitic structure.

The Searsmont, Maine, meteorite, which fell May 21, 1871, at 8 A. M., was embedded two feet in the ground and broken into several fragments. Its total weight was twelve pounds. It contained of nickeliferous iron, 14.62; stony matter, 85.38 per cent.

Dr. J. Lawrence Smith observed at Louisville, Kentucky, just after sun-

† C. S. Lyman in American Journal, September, 1860.
|| H. A. N., in American Journal of Science, May, 1862.

down on the 12th December, 1874, a large red light suddenly appearing in the zenith, and for several seconds seemed to stand motionless, it apparently descending directly in a line to the observer; then starting off with an uncertain, fluttering motion, it moved slowly towards the horizon in a southerly direction, gradually fading in its flight, from a lurid red to a dark purplish hue, and leaving a dense stream of blue smoke behind, which remained for several minutes after the disappearance of the meteorite. An observer, eighty miles east of Louisville, saw it appear almost due west, about 30° above the horizon, and moving rapidly southward, inclined to the horizon, and disappearing about 20° above it, leaving a bright track of smoke, at first very luminous, soon fading as the Sun descended lower, then seemed to be wafted into zigzags by a gentle breeze, curling up in folds and disappear ing. Four or five minutes after, three or four loud detonations were heard in quick succession.*

Guernsey County, Ohio, Meteorites.—This remarkable fall took place May 1, 1860. At Cambridge, in Guernsey county, Ohio, (lat. 40° 4′, long. 81° 35′), about twenty minutes before 1 P. M., three or four distinct explosions were heard, like firing of heavy cannon, with an interval of a second or two between each report. This was followed by sounds like firing of musketry, ending with a rumbling sound like distant thunder, which lasted for two or three minutes. The meteors were seen to pass and heard by persons in Washington, Noble, Guernsey and Muskingum counties, Ohio, and at Parkersburg, West Virginia. Houses were shaken at Parkersburg as if by an earthquake, and throughout the path in the above named counties. The direction of the meteorites was from southeast to northwest, striking the ground at an angle of 60°. Prof. Evans calculated its velocity to be about four miles per second. In Washington county, near Noble, it was about forty-three miles high, and nearly forty-one miles over Noble county, a few miles south of Sarahsville. About this point of its patch it exploded, the fragments passing on struck the ground at various places in the southwest part of Guernsey couunty. Soon after falling they were quite warm. Thirty fragments of various sizes from half a pound to one hundred and three pounds were picked up. The stones had a coarse gray appearance, with a black crust, and contains: Nickeliferous iron, 10.7; earthy minerals, 89.3. The nickeliferous particlès contain minute traces of cobalt, copper, phosphorus and sulphur.†

Iowa County, Iowa Meteorite.—Mr. C. W. Irish, of Iowa City, in an interesting pamphlet, informs us that this meteor struck our atmosphere at 10:20 P. M., February 12, 1875, in N. lat. 40°, W. long. 93°, over the northern part of Missouri; it moved from South to North, curving eastwardly, and exploded in N. lat. 40° 53′, W. long. 91° 40′; its visible path being 112 miles north and 47 miles east, and was visible about ten seconds. Observers say that its light was very intense, the nucleus round and as bright almost as the Sun. It sparkled and quivered like the twinkling of a star, with now

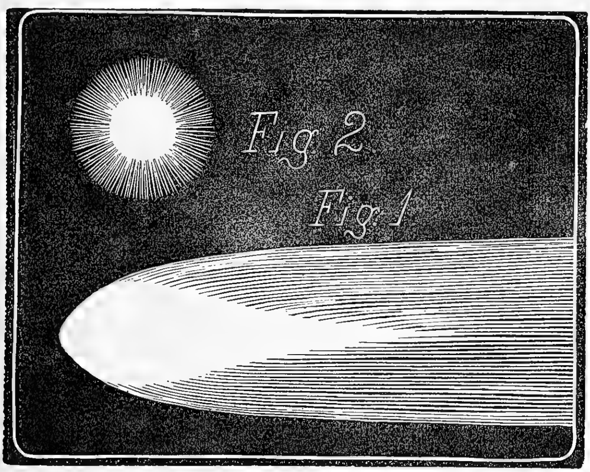
* Dr. J. Lawrence Smith, in American Journal of Science, Sept. 1875
† Dr J. Lawrence Smith's Scientific Researches

and then a vivid flash. Its size and motion seemed to increase towards the zenith, when it seemd to start suddenly and dart away on its course. All observers who were in twelve miles of the line of its path, say it threw down sparks which drifted eastward. Their clouds of smoke or vapor followed in its track, at times overtaking it, and then were lost. A bright deep red with flashes of green and other prismatic colors, appeared around the nucleus or at the forward part of it. From three to five minutes after vanishing, observers near the south end of its path, heard an intensely loud and crashing explosion ; this was followed by a rushing rumbling sound that seemed to follow the path of the meteor, and at intervals, as it rolled away northward, varied by sounds of distinct explosions, growing fainter as it continued, until at last it died away in three to five explosions, much fainter than the others. One and a half to two minutes after, five quickly recurring reports were heard, reverberating with terrific force, quickly succeeded by and almost blending with these reports, came hollow bellowings and rattling sounds.

The meteor was seen at Red Wing, Minnesota, 186 miles; at Rockford, Illinois, 150 miles ; at Omaha, Nebraska, 190 miles; and at St. Louis, Mo., 214 miles distant from the nearest point of the path.

On its path a large mass was separated from the main body and then exploded into many pieces, and passing on about thirty-two miles, fell, the various pieces scattering over the surface for six miles long by one and a half miles wide, falling near Marengo, Iowa county, Iowa. About 150 pieces were picked up, aggregating not less than 500 pounds. Mr. Irish estimated the velocity in our atmosphere at twenty-one miles per second ; also, that before it divided it was about forty feet diameter, with a train of 9°, or seven to twelve miles long.

The annexed cuts, copied from Mr. Irish's pamphlet, and by his permission inserted here, show the appearance of the meteor as seen from two directions at right angles to each other. Figure 1, as seen from persons west of it, and Figure 2, as seen by persons in front.



The greatest diameter of the white portion is forty feet, and of the meteoric mass 100 feet. A side view of the nucleus shows the common pear shape of most solid meteors when in motion. An analysis of this stone by G. Hinrich, gave: Troillite, 1.8, olivine, 52.8; pyroxene, 44.9. A piece in my possession is of a gray color with brown specks, and very much resembles the Guernsey meteorite. It also has a black crust.

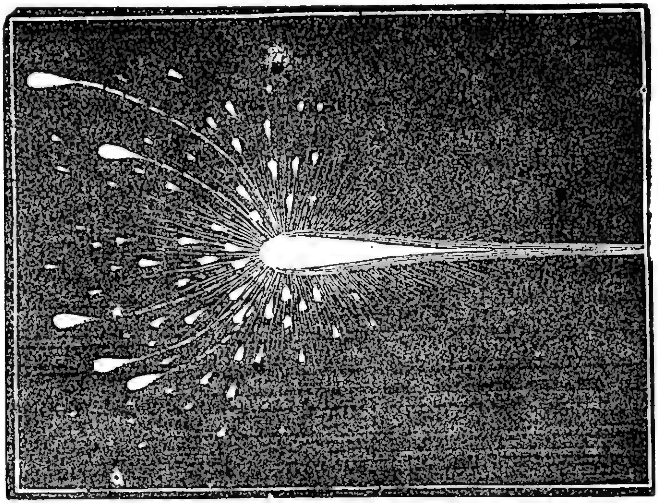


FIGURE 3. Another view of the Iowa Meteor.

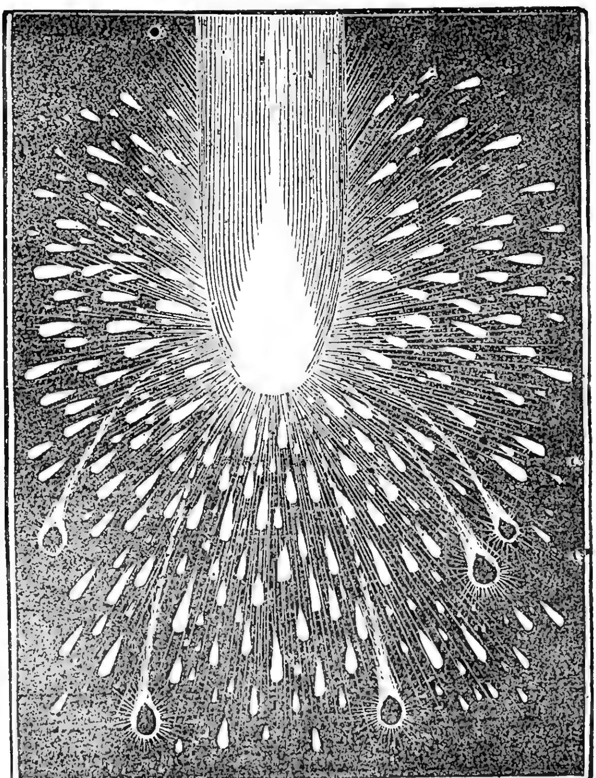


FIGURE 4. Another view of the Iowa Meteor when near the end of its flight.

MISSOURI METEORITES.

It was my good fortune to see one meteor in broad day light, of a clear day, at 9 A. M., September 30, 1865, about half way between Pleasant Hill and Harrisonville, Cass county, Missouri. It appeared in the northwest at an elevation of 30° above the horizon, moving rapidly southwest at about 10° angle with the vertical, emitted sparks and vanished before reaching the Earth.

On the 27th day of December, 1875, about 9 P. M., a brilliant meteor was seen to dart across the northern sky, from West to East, being chiefly observed in Northwest Missouri, illuminating the heavens for a few seconds, brighter than the brightest moonlight, then bursting into fragments. After a few minutes interval, a sound as of distant thunder was heard. The explosion was only heard in Northwest Missouri, although the meteor was seen as far south as Nevada, Vernon county, and Clinton in Henry county. It was seen at Lawrence, Kansas, at Council Bluffs and Iowa City, Iowa; Falls City, Nebraska; at Oregon, St. Joseph, Kansas City, Kirksville, and St. Louis, Missouri; at Cincinnati, Ohio, and Ripley, Indiana.

Mr. William Kaucher of Oregon, Holt county, Missouri, observed it near the Constellation Gemini, passing near Procyon, and beyond, exploding 30° below that star, and 20° above the horizon, in the southeast. Explosions were heard three minutes later.

At St. Jo. it appeared near the zenith, of dazzling brightness, passing eastwardly, exploding and emitting sparks like a rocket, then disappearing. It first appeared red, then blue, then white and bright. Its nucleus appeared one-half the size of the Moon, according to one person, while another person thought it about four times the size of the Sun; a fiery sheet, and emitting sparks. About three minutes thereafter a noise was heard, resembling thunder, followed by a deep rumbling noise, continuing for about sixty seconds. At Savanna, Andrew county, it seemed to come from the North-northwest and passed to South-southeast, exploding 5° to 12° above the horizon. An explosive sound was heard about three minutes after. At Rockport, Atchison county, it was seen passing southeastwardly. At Pleasant Hill, Cass county, the sky seemed brightly illuminated, and immediately afterwards a bright nucleus or ball of fire with a short tail, appeared in the Northwest, shooting up like a rocket from the horizon towards the zenith, and descending eastwardly. At Clinton, Henry county, Missouri, it passed across the northern sky at 30° elevation, its nucleus appearing twice the diameter of the Sun, with a long luminous tail of a blueish violet color. At Kirksville, Adair county, it was observed 10° to 15° Northwest, at an altitude of 30° to 40°.

Mr. C. W. Irish, of Iowa City, Iowa, observed it at South 60°, West elevation 65°, and thinks that it fell a few miles Southeast of Eagleville in Harrison county. I could hear of no explosion being heard in the counties just south and west, but it was last seen overhead in the southwest part of Linn county.

Many of us saw the very remarkable and brilliant Meteor of December 21, 1876. "It was seen between 8:40 and 9 P. M., from Kansas to Pennsylvania; first appearing nearly over Topeka, Kansas, at an altitude of about sixty miles, thence passing over the centre of North Missouri, exploding several times, crossed the Mississippi between Hannibal and Keokuk, then broke into several pieces, as proved by explosions heard over Central Illinois, between St. Louis and Chicago. The path was nearly parallel to the Earth's surface, and nearly a straight line a 1,000 miles long, occupying as variously estimated, from fifteen seconds to three minutes time. It entered our atmosphere dipping but little from 30° from the Earth's motion, and was overtaking the Earth with a relative slow velocity. It must have been coming from a point in the eastern or southern part of the Constellation Capricornus."* Prof. Daniel Kirkwood, of Bloomington, Indiana, says:† "At 8:45 P. M., a fireball, accompanied by a large number of smaller meteors, was seen in the northern heavens, moving eastward. It appeared 12° to 15° north of west, and 10° above the horizon. Its greatest altitude at Bloomington was 20°, disappearing in the northeast at 5° above the horizon. Its motion was remarkably slow. Many of the smaller meteors appearing about the size of Venus. Some minutes thereafter a rumbling sound was heard. Near Columbus, Ohio, the flock was seen, of forty to sixty, moving as regularly as a flock of geese." It consisted in fact of a large flock of brilliant balls chasing each other across the sky.

At Oregon, Missouri, its apparent size was that of the Moon, passing over the Stellar vault (Mr. Kaucher says) at 8:20 P. M., from near the horizon in the southwest, crossing the meridian at 55° elevation. Light fleecy clouds were seen at this time displaying all the colors of the rainbow.

At Clinton, Missouri, Dr. John H. Britts observed it at 8:20 P. M., in the northwest, at 35° elevation, and passing eastwardly, appearing of a very bright yellow color, and of the size of the full Moon, with a short train which quickly faded away. In the east it seemed to give off several fragments that assued a globular form, and seemed to fall behind and below the main body, disappearing about the same time, each with its own train.

Observers at Pleasant Hill, Missouri, say it emitted sparks just before it disappeared below the horizon, and produced a light greater than moonlight. The only piece seen to fall fell at Rochester, Indiana. Prof. Shepard‖ describes this stone as of a gray color, with a specific gravity of 3.55, rather soft, with a small per cent. of metallic iron.

Prof. J. Lawrence Smith§ describes this stone as of a grayish pisolitic character, very friable, with a dull black coating and composition.

Nickeliferous iron	10.
Troillite	3.
Chrome iron	0.15
Olivine minerals	41.00
Bronzite and pyroxene	46.00
Cobalt—minute traces.	

* H. A. N., in American Journal of Science, Feb. 1877. † American Journal of Science.
‖ American Journal of Science, March, 1877. § American Journal of Science, Sept. 1877.

Warren County Meteorite.—On the morning of January 3d, 1877, just about sunrise, as some wood-choppers were grinding their axes, they heard a rushing sound in the air. Looking up, they beheld something strike the limbs of the trees, dash through them and strike the ground. It seemed to them to come from the northwest, and was of a somewhat conical shape, with a probable weight of about 100 pounds.

I visited the locality about two weeks after, ascertained the locality of the fall to be Sec. 2, T. 46, R. 2, W., or about 4 miles southeast of Warrenton. That the meteor came from the northwest, striking the ground at about an angle of 45°, crushing through the branches of a sugar tree, breaking some limbs an inch in diameter. It seemed to have struck the side of the tree, passing into the frozen ground about 4 inches, one piece flying off about 70 feet to the left; other fragments rebounding about 75 feet in front. It was of a bluish gray color, quite firable, and of rather coarse texture, with a black crust upon the outside nearly a sixteenth of an inch thick.

Dr. J. Lawrence Smith determined the specific gravity to be 3.47, and composition—

Nickeliferous iron	2.01
Olivine minerals	76.00
Bronzite and Pyroxene	18.00
Troillite	3.50
Chrome iron	0.50

Minute traces of Cobalt.

Mr. Irish, of Iowa City, Iowa, informs me that at sunrise on the morning of the 3d there was observed, at an elevation of 60°, and reaching to the horizon, a vivid and prolonged flash of a white light, and wide as the full moon, beginning at a point and widening out as it proceeded. It disappeared in the horizon at about S. 23°, E. true course.

Mr. J. E. Johnston, of Decatur, Ills., saw the same flash at sunrise; a broad, bright track, beginning at 50° to 70° elevation, and running perpendicularly to the horizon. Its vanishing point bore S. 54°, 30° W. magc.

Other less important falls are noted as having taken place in Missouri, but the information concerning them is imperfect.

Dr. B. F. Shumard communicated to the St. Louis Academy of Science, and to the *American Journal of Science*, a notice of a fall having taken place in St. Louis, at 11 A. M. of July 9th, 1862, of a very small meteorite. None of the common minerals found in meteorites were recognised, except iron, hence Dr. S. himself seemed to doubt its being a meteorite.

Between 9 and 10 A. M., June 25, 1876, a small meteorite is stated to have fallen upon the roof of Mr. Isaac Whitaker's house, No. 556 Main street, Kansas City, cutting a hole through the tin, but not passing through it. Mr. J. D. Parker describes it in the *American Journal of Science*, Oct., 1876, as being about one-third of an inch in thickness and resembling sulphuret of iron. I have not heard of its being subjected to chemical analysis.

Between half-past 5 and 6 P. M. of Dec. 2d, 1877, a brilliant meteor passed across, from west to east, at probably not over 30° elevation. It was seen at Pleasant Hill and Kansas City.

The WESTERN REVIEW OF SCIENCE chronicles the fall of another meteor on Nov. 29th, at about 6 P. M., that was seen at Kansas City.

Three or four pieces of meteoric iron have been found in different portions of Missouri, of which we possess no record of their time of fall. The largest was obtained by myself, from Bates County, in 1875. It was discovered near Butler. (Lat. 38° 20′ N., Long. 94° 22′ W.) A blacksmith in Butler heated it in order to cut off pieces; one piece of two pounds occupying him about two hours in cutting off. When I obtained the mass it weighed just 85 pounds, probably four or five pounds having been already cut off. Being exposed a long time, it had a thick rusty coat on its surface. The metal is very tough, and shows when cut many nodules of Troillite. I counted fourteen, varying in size from one-eight to an inch, and fifty-eight smaller ones, some mere specks. The Widmanstattian figures were finely developed, and show four systems of lines, of which one system crosses the lines of another at 60°, one at about 78° and one at about right angles. It measures in extreme length ten and a half inches by seven n height, and of irregular shape. An analysis by Dr. J. Lawrence Smith, gave, specific gravity, 7.72. Its composition:

Iron	89.12
Nickel	10.02
Cobalt	.26
Copper	.01
Phosphorus	.12

The troillite has a specific gravity of 4.73.

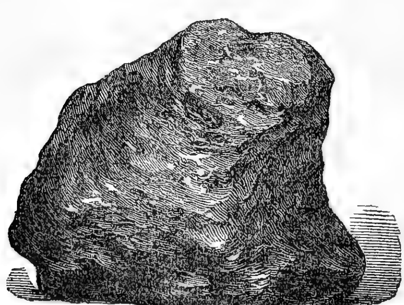


FIGURE 3. Bates County Meteorite, (one-sixth size) from photograph.

FIGURE 6. Bates County Meteorite, (one-third size) showing polished surface, nodules of Troillite, and Widmanstattian lines, the latter enlarged out of proportion for the sake of distinctness.

Prof. C. U. Shepard, in the *American Journal of Science*, for September, 1860, mentions an iron meteorite from near Forsyth, Taney county, Mo. From Prof. Shepard's description I suppose that it was chiefly composed of iron and nickel, and had a specific gravity of 4.46.

In Prof. C. U. Shepard's catalogue of meteorites, published in the *American Journal of Science and Arts* for May, 1861, we also find No. 57, February 13, 1839, a meteorite from Little Piney, Pulaski county, Mo.

Prof. Daniel Kirkwood catalogues eight bolides between July, 1876, and February, 1877; one of July 8, 1876, at 8:45 P. M., at an altitude of eighty-six miles, passed across Northeast Indiana, bearing N. 78° W., exploding at an elevation of thirty-four miles above Lake Michigan. Its path was inclined 21° to the horizon.

Before closing, I would insert the following extract from the History of Louisiana, by Le Page Du Pratz, Paris, 1758; London Translation, 1774. A friend of mine kindly copied and sent me the account:

"Towards the autumn of this year (1722) I saw a phenomena which struck the superstitious with great terror. It was in effect so extraordinary that I never remember to have heard of anything that either resembled or ever came up to it. I had just supped without doors in order to enjoy the cool of the evening; my face was turned to the west, and I sat before my table to examine some planets which had already appeared.

"I perceived a glimmering light which made me raise my eyes, and immediately I saw at the elevation of about 45 degrees above the horizon a light proceeding from the south of the breadth of three inches, which went off to the north, always spreading itself as it moved, and made itself heard by a whizzing light like that of the largest skyrocket. I judged by the eye that this light could not be above our atmosphere, and the whizzing noise that I heard confirmed me in that notion."

"When it came to be about 45 degrees to the north above the horizon it stopped short and ceased enlarging itself. In that place it appeared to be about twenty inches broad, so that in its course, which had been very rapid, it formed the figure of a marine trumpet, and left in its passage very lively sparks, shining brighter than those which fly from under a smith's hammer; but they were extinguished almost as fast as they were emitted."

"At the north elevation there issued out with a great noise from the middle of the large end a ball quite round, and all on fire apparently, six inches in diameter. It fell below the horizon to the north and emitted about twenty minutes after a hollow but very loud noise for the space of a minute, which appeared to come from a great distance. The light began to be weakened to the south, after emitting the ball, and at length disappeared before the noise was heard."

GEOGRAPHICAL.

PLAN FOR THE EXPLORATION OF THE ARCTIC.*

FURNISHED BY CAPT. H. W. HOWGATE, U. S. A.

The plan of Arctic Exploration and Discovery, in furtherance of which I have the honor of appearing before you this evening, is one to establish a colony of hardy, resolute and intelligent men at some favorable point on or near the borders of the Polar Sea and providing it with all modern appliances for overcoming the physical obstables in the pathway to the Pole, and for resisting the effects of hunger, of cold, and of sickness, to deprive it of the means of retreat, except at stated periods of time. The location selected as the site of the proposed colony is on the shore of Lady Franklin Bay, near the seam of coal found by the "Discovery," of the English expedition of 1875.

The idea of establishing such a colony is not a new one, as it was advocated by Dr. Hayes as far back as 1862, and has since that date been approved by this society and by the action of foreign societies and explorers. This fact accounts, in great part, for the almost unanimous support with which the so-called Howgate plan has been received.

The results of the last English expedition, and modern improvements in means of locomotion and communication, render it possible to locate farther north than in the earlier days of Arctic exploration, when sailing vessels were used.

The expedition of Captain Hall in the Polaris, in 1871, and of Captain Nares in the Alert and Discovery, in 1875, have shown that, by the use of steam, it is a comparatively easy matter to reach the entrance to Robeson's Channel in latitude 81° north, and that the serious difficulties to be overcome lie beyond that point. Parties from these two expeditions have made fair surveys 140 miles north of this point, leaving about 400 miles of unexplored regions between it and the goal of modern geographers—the Pole.

When Captain Hall reached the upper extremity of Robeson's Channel the lookout of the Polaris reported open water in sight and just beyond the pack which surrounded the vessel and impeded further progress. This open water was afterwards seen from the cape at the northern opening of Newman's Bay, and it was the opinion of the crew of that ill-fated vessel, that if she had been but the fraction of an hour earlier in reaching the channel, they could have steamed unobstructed to the Pole itself, or to the shores of such lands, if any exist, as may bound the so-called open Polar Sea. We know that they did not succeed, but were forced to winter almost within sight of this sea, and subsequently, disheartened by the loss of their gallant commander, abandoned the enterprise.

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* A paper prepared by Capt. Howgate, and read at the meeting of the American Geographical Society in New York, January 31, 1878.

Where this open water was found, Captain Nares, in 1875 and 1876, found solid, impenetrable ice, through which no vessel could force its way, and over which it was equally impossible for sled parties to work.

These facts appear to show that, within the Arctic circle the seasons vary as markedly as in more temperate southern latitudes, and that the icy barriers to the Pole are sometimes broken up by favoring winds and temperature. To get further north, or to reach the Pole, prompt advantage must be taken of such favoring circumstances, and to do this with the greatest certainty and with the least expenditure of time, money, and human life, it is essential that the exploring party be on the ground at the very time the ice gives way and opens the gateway to the long-sought prize, fully prepared to improve every opportunity that offers.

The permanent colony should be furnished with provisions and other necessary supplies for three years, and should consist of at least fifty selected men, mustered into the service of the United States, three commissioned officers, and two surgeons, all to be selected with a view to their especial fitness for the work—young, able-bodied, resolute men, who can be depended upon to carry out instructions to the extreme limit of human endurance. An astronomer and two or more naturalists, to be selected by the National Academy of Sciences, and to work under instructions from that body, but subject to such general supervision and directions from the head of the expedition as is customary at all posts in charge of an officer of the United States, should accompany the expedition. One or more members of the regular force should be competent to make meteorological observations, and to communicate by telegraph and signals whenever such communications become necessary. An annual visit should be made to the colony to carry fresh food and supplies; to keep the members informed of events occurring in the outside world, and bear them news and letters from anxious relatives; to bring back news of progress made and of a private character to friends; also, if necessary, to bring back invalided members of the expedition, and carry out fresh colonists to take their places. In this way the morale of the colony would be maintained and the physique of its members kept constantly at the maximum, and the knowledge that this annual visit would be made, would do much to alleviate the discomforts of the long Arctic night, and the feeling of isolation so graphically described by Arctic explorers.

Captain Hall spent eight years among the Esquimaux, and each year found himself better fitted to withstand the severity of the Arctic circle, and the colony would, it is believed, in like manner become acclimated, and eventually succeed in accomplishing the long-sought end.

With a few strong, substantial buildings, such as can be easily carried on shipboard, the members of the colony could be made as comfortable and as safe from atmospheric dangers as are the men of the Signal Service, stationed on the summits of Pike's Peak and Mount Washington, or the employès of the Hudson's Bay Company, stationed at Fort York, or elsewhere, where a temperature of—60° is not uncommon.

A good supply of medicines, a skillful surgeon, and such fresh provisions as could be found by hunting parties would enable them to keep off scurvy and maintain as good a sanitary condition as the inhabitants of Godhaven, in Greenland. Game was found in fair quantities by the Polaris party on the Greenland coast, and by those from the Alert and Discovery, on the mainland to the west, especially in the vicinity of the last-named vessel, where fifty-four musk-oxen were killed during the season, with quantities of other and smaller game. The coal found by the Discovery's party would render the question of fuel a light one, and thus remove one of the greatest difficulties hitherto encountered by Arctic voyagers.

There seems to be little doubt that Lady Franklin Bay can be annually reached by a steam-vessel, as Capt. Hall went as high as Cape Union, between latitude 82° and 83° with the Polaris, and Capt. Nares still higher with the Alert. It is possible that the last-named point may be reached with the vessel, in which case coal and provisions could be deposited there to form a secondary base of operations for the exploring party. If this latter can be done, the road to the Pole will be shortened by about ninety miles in distance, and three weeks or more, in time—two very important items. It should be clearly understood, that the only use to be made of the vessel which it is hoped to obtain from the Government, is in the transportation of the men and supplies to the location of the colony. When this is done, the vessel will return to the United States and await further instructions. To the expeditionary corps brought from the United States should be added a number of Esquimaux families to serve as hunters, guides, &c., and also an ample number of Esquimaux dogs, so indispensable for sledging, and so useful as food when their capacity for work is gone.

The colony should be kept under the strictest discipline, and to this end should be formally enrolled in the military service, save perhaps the strictly scientific members. By discipline only can such control be exercised as will be indispensable to the successful prosecution of the work. One cannot read, without pain, the account of the Polaris expedition, where the bonds of discipline, only too loose before Hall's untimely death, were entirely relaxed after it. The first in command of the new expedition should be a man able not only to gauge men, but to control them, and his second should be like unto him. Enthusiasm and energy are desirable, but coolness of temper, firmness of rule, persistency of purpose, and a well-balanced mind, fertile in resources and expedients, are indispensable to success.

The outfit of the expedition should include among other things, an ample supply of copper telegraph wire to connect the colony at Lady Franklin Bay with the subsidiary depot at Cape Union, and thence northward, as far as practicable. Copper wire is strong, light, flexible, and a good conductor, and can be worked while lying upon the dry snow or ice without support. The necessary battery material and instruments should be taken to equip the line, and the battery left permanently at the bay station, where, fuel being abundant, it could be kept from freezing. A special form of instrument has been devised for the expedition, by which the use of battery is dispensed with entirely, and it is possible that the recently-discovered telephone may be applied to advantage. It should certainly form a part of the outfit. Much attention has been given to the possible use of balloons as a means of observation and perhaps of exploration. I am now in correspondence with distinguished aeronauts in this country and in France upon the subject, and a series of experiments has been instituted to determine the practicability of obtaining a suitable material for the covering of the balloons that will resist low temperature. Here, as elsewhere, the coal mine plays an important part, as by its aid the necessary supply of gas can be readily and quickly procured.

A few sets of signal equipments, such as are used in the army Signal Service, would also form an important part of the outfit, and all of the men should be instructed in their use, and in the Signal code. Thus provided with means of communication, parties could move forward with confidence, as they would be able, when necessary, to call upon their comrades, who remained behind, for advice or assistance. The existence of coal at the "Discovery's" winter quarters determines the question of colonization and the location of the colony as a means of Polar exploration; and the Nares expedition would have been a success if it had done nothing more than this. The failure of his admirably equipped expedition to reach the Pole is, in a great measure, attributable to the abnormally cold season and the exceptional character of the winds, which had resulted in the formation of ice ridges running across the line of march, thus making progress difficult, slow and dangerous. It is reasonable to suppose, from past meteorological records, that these unusual conditions will not exist during the present season, and indeed may not occur again for several years. Instead of discouraging further effort, the result of Nares' expedition, from the causes named, should stimulate fresh endeavors, and hold out a fair prospect of success. In any event, the little colony on Lady Franklin Bay during their three years' residence, besides having the opportunity of selecting an open season and becoming thoroughly hardened and acclimated, would have their work narrowed down to a common focus—the path-way due north. The work of the Nares expedition clears the way for the final solution of the Arctic problem.

To carry out the plan thus briefly sketched, it is desirable to secure the use of a government vessel, and, inasmuch as its object is one of national interest, such other Government aid as might be necessary and proper; and accordingly, a bill to "authorize and equip an Expedition to the Arctic Seas" was introduced in the House of Representatives January 8th, 1877, by Mr. Hunter, of Indiana, and referred to the Committee on Naval Affairs, from which it was favorably reported by Mr. Willis, of that committee, February 22nd, 1877. In the Senate the same bill was introduced by Mr. Dawes, and referred to the Committee on Naval Affairs, February 9th, 1877. The pressure of other and more important business then occupying the attention of Congress and of the nation, prevented further action during the session, which closed on the 3rd of March last. The subject was found, however, to be one of national and universal interest, and received the hearty commendation and support of former Arctic explorers, of geographers, and of men eminent in the several walks of science, among whom I may name the distinguished President of this Society and the Hon. I. I. Hayes, both of whom have from the first given me their warmest encouragement and the benefit of their wide experience. Professor Joseph Henry, of the Smithsonian Institute, Professor Elias Loomis, of Yale College, President Potter, of Union College, Admiral Porter, of the Navy, the then Secretary of the Navy, and most of the officers and crew of the *Polaris*, with many others, have given the weight of their names and influence in support of the enterprise in this country, while abroad I have abundant evidence of interest from members of former expeditions, notable among whom are Dr. John Rea and Captain Kennedy, of English fame, and Lieutenant Payer, of the Austro-Hungarian Expedition.

As practical evidence of the interest felt in the subject in this country, a number of public spirited and generous citizens, among whom, it is a pleasure to state, those of this city occupy the foremost place, having faith in the success of the colonization plan as a means of Arctic exploration, and believing in its ultimate approval by Congress, contributed from their private means a sufficient sum for the purchase and outfit of a small vessel to be sent to the Arctic seas for the purpose of collecting such supplies during the ensuing winter as might be useful for the main expedition of 1878, if that expedition should be authorized. It was at first intended to limit the mission of this vessel to the collection of material only, but the opportunity for scientific investigation was so inviting, and the added cost incurred thereby so very trifling in comparison with the results to be attained, that space was made on board for two observers and their necessary apparatus. One of these observers was selected on the recommendation of Professor Elias Loomis, of Yale College, and instructed to pay especial attention to meteorological phenomena, while the other was selected as naturalist of the expedition by Professor Spencer F. Baird, of the Smithsonian Institute, from whom he received special instructions.

This vessel, the *Florence*, sailed from New London August 3d, with a crew of thirteen men, all told, commanded by Capt. Tyson, of "Polaris" fame, and reached the head of Cumberland Gulf on September 13th, where she has gone into winter quarters. Captain Tyson's instructions are to collect such supplies as his experience shows to be necessary for the use of the future colony, and to join the vessel carrying the members of the colony at Disco in August next, and in the event of its non-arrival, to return to the United States.

There is reason to hope, from the knowledge and attainments of the two scientific gentlemen accompanying the *Florence*, that the little vessel will, on her return, add no small quota to our knowledge of Arctic cosmogony and phenomena. But however that may be, her loss or safety must remain a closed book to us for many months to come. What perils she may meet, what dangers dare, what obstacles overcome, we can neither know nor forecast, but she and her gallant crew are none the less in the hands of Him who rules the ice-bound waste as surely as He rules this crowded city, and without whose paternal knowledge not even the sparrow falls.

To guard against possible delay, in the event of Capt. Tyson's failure to reach Disco at the proper time or without proper supplies, the Danish Government has been requested to delay the shipment of furs from that point until the middle of August, in order that a supply may be purchased from that source if necessary.

As soon after the opening of the present session of Congress as practicable, the bill to authorize the expedition was offered in the Senate and House of Representatives, and in both referred to the Naval Committee. The House Committee, through Mr. Willis, of New York, who from the first has been an active friend of this measure, has renewed its favorable report of last session, and the bill is now awaiting the final action of the House upon it. From the Senate Committee I have the assurance of a favorable report. Senators Sargent and McPherson, having immediate charge of the bill, have exhibited a gratifying interest in its success, and it is reasonable to hope for its final passage.

In Paris, M. de Fonvielle, who is well known as an accomplished aeronaut and man of letters, is making a series of balloon experiments for the benefit of the future colony, in the foundation of which he takes a lively interest, and the French Geographical Society, at its last regular session, formally expressed its approval of the plan. The Bremen Geographical Society, through its Secretary, Dr. Lindeman, had previously expressed a similar approval, and everything seems working favorably toward the accomplishment of the desired end; even the mighty forces of nature and the changeful seasons appear to labor for the success of the expedition; for the present winter, of such unprecedented mildness, will undoubtedly retard the formation of ice in the Polar basin, and leave a freer passage for the colony next summer, up Baffin's Bay to Kennedy and Robeson's Channels. The great veteran explorer, Professor Nordenskiold, and the favorable reports which he brings back with his expedition just returned, with the wonderful voyage of Captain Wiggins from the mouth of the Yenessei along the Siberian coast and through the Kara Sea, all demonstrate that the open season has unsealed the ice of higher latitudes, and points to a favorable northward passage during the coming summer.

I have not touched this evening upon the vast interests to science which Polar expeditions represent, and the important questions which they alone can solve, nor upon the geographical theories and arguments in support of the different routes that might be followed, preferring to leave the settlement of these subjects to more competent hands. The noble Earl who honors us with his presence this evening, and who has won distinction in Arctic fields as well as in those of statesmanship, and Dr. Hayes, whose triumphs as an explorer have been supplemented by those accorded to the successful legislator, can tell us with the graphic tongue of eyewitnesses, the wonders of the strange lands we seek to colonize, and whose hidden secrets we seek to solve; for both have watched the colossal or fairy shapes of mountainous icebergs with their changeful play of hues under the midnight sun, or the mighty arch of the aurora, with its trailing fringes of incandescent colors spanning through the long night of Arctic winter, the mystic sea of ice and silence. Their presence, and that of the other distinguished gentlemen who are announced to address us, and whose names are as familiar as household words wherever the English language is known or spoken, I hail as an augury of success, and I heartily join with them and you in doing honor to the name and achievements of our countryman Stanley, in penetrating the wilds of Africa. There is no city throughout the whole broad Union more suitable for such a meeting as the present, a city where the memory of Grinnell, the great and public-spirited merchant, is still green, and where so many others, their hearts as generous as their means were large, have given freely of their store to aid in Arctic discovery and in whatever else was good and noble in art and science, in love and charity.

In closing, permit me at present to thank you all for your attention and your kindly manifestation of interest in the subject, and to hope that such action will be taken by Congress as will invest it with added interest in the near future.

CHEMISTRY.

LIQUEFACTION OF OXYGEN.

BY M. RAOUL PICTET.

The object which I have had in view for more than three years is to demonstrate experimentally that molecular cohesion is a general property of bodies, to which there is no exception.

If the permanent gases are not capable of liquefying, we must conclude that their constituent particles do not attract each other, and thus do not conform to this law.

Thus, to cause experimentally the molecules of a gas to approach each other as much as possible, certain indispensable conditions are necessary, which may be expressed thus:—

1. To have the gas absolutely pure, with no trace of foreign gas.
2. To be able to obtain extremely energetic pressures.
3. To obtain intense cold, and to subtract heat at these low temperatures.
4. To utilize a large surface for condensation at these low temperatures.
5. To be able to utilize the rapid expansion of the gas from extreme condensation to the atmosphere pressure—an expansion which, added to the preceding means, will compel liquefaction.

Having fulfilled these five conditions, we may formulate the following alternative :—

When a gas is compressed to 500 or 600 atmospheres, and kept at a temperature of − 100° or − 140°, and it is allowed to expand to the atmospheric pressure, one of two things takes place :—

Either the gas, obeying the force of cohesion, liquefies, and yields its heat of condensation to the portion of gas which expands and loses itself in the gaseous form ; or, on the hypothesis that cohesion is not a general law, the gas must pass to the absolute zero and become inert—that is to say, an impalpable powder.

The work done by expansion will not be possible, and the loss of heat will be absolute.

Struck with the truth of this alternative, which is rendered certain by thermo dynamic equations based on accurate data, I have sought to produce a mechanical arrangement which should entirely satisfy these different conditions, and I have chosen the complicated apparatus of which the following is a brief description :—

I take two pumps for exhaustion and compression, such as are used industrially in my ice making apparatus. I couple these pumps in such a way that the exhaustion of one corresponds to the compression of the other. The exhaustion of t e first communicates with a tube of 1.1 metres long and 12 5 centimetres in diameter, and filled with liquid sulphurous acid. Under the influence of a good vacuum the temperature of this liquid rapidly sinks to − 65°, and even to − 73°, the extreme limit attained.

Through this tube of sulphurous acid passes a second smaller tube of 6 centimetres in diameter, and the same length as the envelope. These two tubes are closed by a common base.

In the central tube is retained compressed carbonic acid produced by the reaction of hydrochloric acid on Carrara marble. This gas, being dried, is stored in an oil gasometer of 1 cubic metre capacity.

At a pressure of from 4 to 6 atmospheres the carbonic acid easily liquefies under these circumstances. The resulting liquid is led into a long copper tube 4 metres in length and 4 centimetres in diameter.

Two pumps, coupled together like the first, exhaust carbonic acid either from the gasometer or from the long tube full of liquid carbonic acid.

The ingress to these pumps is governed by a three-way tap. A screw valve cuts off at will the ingress of liquid carbonic acid in the long tube ; it is situated between the condenser of carbonic acid and this long tube. When this screw valve is closed, and the two pumps draw the vapor from the liquid carbonic acid contained in the tube 4 metres long, the greatest possible lowering of temperature is produced ; the carbonic acid solidifies and descends to about − 140°. The subtraction of heat is maintained by the working of the pumps, the cylinders of which take out 3 litres per stroke, and the speed is 100 revolutions a minute.

Both the sulphurous acid tube and the carbonic acid tube are covered with a casing of wood and non-conducting stuff to intercept radiation.

In the interior of the carbonic acid tube passes a fourth tube, intended for the compression of oxygen; it is 5 metres long and 14 millimetres in external diameter. Its internal diameter is 4 millimetres. This long tube is consequently immersed in solid carbonic acid, and its whole surface is brought to the lowest obtainable temperature. These two long tubes are connected by the ends of the carbonic acid tube, consequently the small tube extends about 1 metre beyond the other. I have curved this portion downward and given the two long tubes a slightly inclined position, but still very near the horizontal.

The small central tube is curved and screws into the neck of a large howitzer shell, the sides of which are 35 millimetres thick; the height is 28 centimetres, and the diameter 17 centimetres.

This shell contains 700 grms. of chlorate of potash and 256 grms. of chloride of potassium mixed together, fused, then broken up, and introduced into the shell perfectly dry. When the double circulation of the sulphurous and carbonic acids has lowered the temperature to the required degree, I heat the shell over a series of gas burners. The decomposition of the chlorate of potash takes place at first gradually, then rather suddenly towards the end of the operation. A pressure-gauge at the extremity of the long tube, lets me constantly observe the pressure and the progress of the reaction. This gauge is graduated to 850 atmospheres, and was made for me expressly by Bourdon, of Paris.

When the reaction is terminated the pressure exceeds 500 atmospheres; but it almost immediately sinks a little, and stops at 320 atmospheres. If, at this moment, I open the screw-tap which terminates the tube, a jet of liquid is distinctly seen to spirt out with extreme violence. I close the tap, and in the course of a few moments a second jet—less abundant, however—can be obtained.

Pieces of charcoal, slightly incandescent, put in this jet inflame spontaneously with inconceivable violence. I have not yet succeeded in collecting the liquid, on account of the considerable projectile force with which it escapes, but I am trying to arrange a pipette, previously cooled, which possibly may be able to retain a little of this liquid.

Yesterday I repeated this experiment before the majority of the members of our Physical Society, and we had three successive jets, well characterized. I cannot yet determine the minimum pressure necessary, for it is evident that I have a surplus pressure produced by the excess of gas accumulated in the shell, and which could not condense in the small space represented by the interior tube.

I hope to utilize a similar arrangement in attempting the condensation of hydrogen and nitrogen, and I am especially occupied with the possibility of maintaining low temperature very easily, thanks to four large industrial pumps which I have at my disposal, worked by a steam engine.

GENEVA, DECEMBER 25, 1877.

Since receiving the above we have been favored with further particulars of an experiment which was performed for the fourth time on Thursday, December 27th, in the presence of ten scientific men—among others Prof. Hagenbach, of Bâle, who came expressly to assist at this important experiment.

At 10 o'clock in the evening the manometer, which had risen to 560 atmospheres, sank in a few minutes to 505, and remained stationary at this figure for more than half an hour, showing by this diminution in the pressure that part of the gas had assumed the liquid form under the influence of the 140 degrees of cold to which it was exposed. The tap closing the orifice of the tube was then opened, and a jet of oxygen spirted out with extraordinary violence.

A ray of electric light being thrown on the escaping jet showed that it was chiefly composed of two parts;—one central, and some centimetres long, the whiteness of which showed that the element was liquid, or even solid; the other exterior, the blue tint of which indicated the presence of oxygen compressed and frozen in the gaseous state.

The success of this remarkable and conclusive experiment called forth the applause of all present.

We understand that Messrs. Pictet & Co., of 22, Rue de Grammont, Paris, are fitting up apparatus with the intention of having these experiments repeated at their Freezing-Machine Works, at Clichy, in Paris.—*London Chemical News*.

LIQUEFACTION OF NITROGEN, HYDROGEN AND ATMOSPHERIC AIR.

M. Cailletet has comunicated to the *Academie des Sciences* some further particulars on the liquefaction of gases, and at the meeting of the 31st of December a paper was read, from which we translate the following:

"*Nitrogen.*—Pure and dry nitrogen compressed to about 200 atmospheres, at a temperature of +13°, then allowed to expand suddenly, condenses in the most perfect manner; it first produces an appearance like that of a pulverized liquid in small drops of appreciable volume; this liquid then gradually disappears from the sides to the centre of the tube, at last forming a sort of vertical column following the axis of the tube. The duration of these phenomena is about 3 seconds.

"These appearances leave no doubt as to the true character of the phenomena. I first tried the experiment at home at a temperature of —29°, and I repeated it yesterday, the 30th of December, several times at the Laboratory of the Ecole Normale, in the presence of many savants and members of the Academy, among whom I am happy to name, with his assent, the venerable M. Boussingault.

"*Hydrogen.*—Hydrogen has always been considered the most incondensable gas, on account of its low density, and the almost complete agreement of its mechanical properties with those of perfect gases. Thus it was only with great doubt as to the result that I decided to submit it to the same tests which had determined the liquefaction of all the other gases.

"In my first attempt I noticed nothing particular, but, as often happens in experimental science, skill in observing phenomena results in causing signs to be recognized under conditions where they had at first escaped nôtice.

"This is what occurred with hydrogen: On repeating my experiments to-day, in the presence of MM. Berthelot, H. Sainte-Claire Deville and Mascart, who have allowed me to quote their testimony, I have succeeded in observing indications of the liquefaction of hydrogen under conditions of proof which have left no doubt on the minds of the scientific men who witnessed the experiment. It has been repeated a great number of times. Operating with pure hydrogen compressed to about 280 atmospheres, and then allowed suddenly to expand, we saw form an extremely attenuated and subtle mist suspended in the gas and disappearing suddenly. The production of this mist, in spite of its extreme subtlety, seemed incontestable to all the scientific men who witnessed the experiment to-day, and who took care to have it repeated several times, so as to leave no doubt as to its reality.

"*Air.*—Having liquefied nitrogen and oxygen, the liquefaction of air is thereby demonstrated. It appears, however of interest to make this the subject of an actual experiment, and, as might be expected, it succeeded perfectly. I need not say that the air was previously dried and freed from carbonic acid. The accuracy of the views expressed by the founder of modern chemistry, Lavoisier, is thus confirmed as to the possibility of causing air to assume the liquid state, and of producing matter gifted with new and unknown properties—views recalled so appropriately at the last meeting of our illustrious perpetual secretary."—*London Chemical News.*

A NEW METHOD OF ILLUMINATING A TOWN

BY PROF. E. L. BERTHOUD, COLORADO SCHOOL OF MINES.

In 1874-75 I was examining the question of the lighting of a small town in Eastern Colorado, and the cheapest and easiest method attainable. I went over the usual routine of gas, petroleum, and all of the so-called cheap gases and gas processes.

Happening to know that the Foreland Light-house in England was illuminated by an electric light, I obtained some data from England in regard to this method, which, successful, has been in use many years, but being originally and then kept up by a large battery, was expensive and rather complicated. Since 1874 however, Mr. Gramme, in France, has invented and patented an easy and cheap method of obtaining a constant flow of electricity by an electrical frictional machine of great power and constancy much superior in cheapness and in constancy to the combination of Daniells or Bunsen's electro-magnetic batteries, of which it would require from 100 to 150 couples to get an electric flow of sufficient power and constancy. Having satisfied myself of the feasibility of using this method of illumination, the next point was to adapt it to our mountain village.

To my surprise I found all the conditions for a successful illumination were easily within reach—half a mile from the centre of the town, and east of it is a high, steep table land, crowned by a castellated crag some 600 feet immediately above the village. Here I propose to place the electrical machine, and the electric light in a glass and iron tower, fifteen feet high, placed on the edge of the crag and immediately overlooking the streets. Placed in a semi-circle before the light will be five Fresnel lenses, each of which will concentrate its rays upon a separate district of the town, or five concave specula; either would answer the desired purpose, and all points in the streets and alleys parallel with the rays from the several lenses or reflectors would be brightly illuminated, while the streets crosswise to the rays would have a shadow side. This shadow side I propose to illuminate by having every 150 feet a lamp-post on the illuminated side provided with a reflector, which would thus throw a bright light across the street and prevent any undue darkening of one side in the shadow of the dwellings.

Another use is suggested for the electric light. In every house or room which presented its end or side towards the electric light, I propose to insert in a hole in the side or end a large glass prism which would reflect the light inside, and thus illuminate the inside of the room brilliantly and intensely, and without the concomitant of fire, explosive petroleum or dirty candles; requiring nothing to keep it in order but a clean cloth or piece of buckskin to wipe it; and which would be readily extinguished by a sliding shutter over the aperture. If preferred, the prism can be placed on the roof, and the rays reflected from above inside, as in a church or large hall; or even in a second story school or lecture room. If to some, the intense brightness of an electric flame is too much for their eyesight, then variously colored prisms can be used to modify the intense light into pleasing softness. We could thus use blue, green, yellow, brown or opal colored prims, shaded to the exact requirements of an artisan's workshop, or to the taste and optical weakness of individual eyesight. An electric light equal in intensity to 350 candles, would, in Colorado, cost 30 cents per hour.

GOLDEN, COL., January 26, 1878.

EASY LESSONS IN CHEMISTRY.—The following names from a recent German journal of chemistry will be good practice in spelling and reading for juvenile students of the science: Methylcarbominthioglycolic acid; dinitribromdiphenylamin; oxaldiphenylguanidin; parabrommetasulphophenylpropionic acid; parapicrylmetanitralin; ethoxilphenilpropyformiate of paratoluilendiamin; methylethylpropylamylammonium oxide hydrate.

FOREIGN CORRESPONDENCE.

PARIS, FRANCE, Jan'y 22, 1878.

There is a decided taste for hygienic studies, and, what is not less important, of applying their lessons. The science of hygiene is not intended to supersede doctors, but to increase the well-being of peoples and of individuals, by augmenting the robustness of their bodies, and consequently the strength of their minds. The role of hygienists is not altogether confined to preserving us from maladies, for there are several very terrible diseases that we are powerless to counteract; still, before destroying the germs of maladies it is prudent on the part of man to endeavor to resist them with success. Moses and Mahomet deserve special honor for the accuracy with which they formulated sanitary rules for public and private life of Oriental people. Perhaps it would be well in the case of Islamism that the verses of the Koran were applied more frequently than they are repeated. The pagan societies of Greece and Rome have leagued us many important hygienic precepts: in the amplitude of their clothing, which left to the articulations and muscles all their suppleness and liberty of action, and in their ablutions, which acted as a tonic for the skin and imparted a general impulsion to the organic functions. The love of the ancients for gymnastic and other corporeal exercises is proverbial, and in their considering Prometheus as the first gymnast, in addition to viewing him as the creator of men, it was merely implied that he developed and renewed life by inculcating the importance of physical exercise. Dr. LeBlond not only advocates but prescribes gymnastics as a curative agent, and the means best calculated to develop the physique of each individual, following sex, age, temperament and profession; to produce in a word, "the soul of a sage in the body of an athlete."

Since the municipality of Paris has fallen asleep over the proposed metropolitan cemetery, the project of cremation is making rapid progress. Opinion is certainly on the point of reclaiming, that a family be allowed the right to incinerate or inhume its dead. The practice of the Middle Ages, in burying the dead beneath the flags of an aisle, is not a whit more insalubrious than interments in church yards in the midst of the living. In 1760, Voltaire complained that "there was not a defunct who did not, more or less, contribute to poison his country." Citizens do not follow that philosopher in his rapture of the pleasure it would be for his fellow-countrymen "to enrich some of the sterile plains of France, and so contribute to abundant harvests; generations would thus become more useful to each other; the towns more healthy, and the fields more fruitful."

Professor Valin continues to demonstrate the necessity of isolation of the sick, as the most effectual plan for checking the propagation of contagious maladies. "Pen the disease, make a void round it, capture it by famine." The most effectual method for counteracting croup, whether in hospitals or families, is isolation. In the case of diphtheria, this plan is adopted in French hospitals, and with great success.

Matter presents itself under three forms: solid, liquid and gaseous. A gas operated upon, under certain conditions, will become a liquid, and the liquid solid. Ice can be changed into water, water into vapor. This rule ought to be general; they are the energetic means alone which are wanting. Faraday liquefied several permanent gases by means of a freezing mixture composed of solid carbonic acid; but several gases, such as oxygen, hydrogen, nitrogen, oxide of carbon and bi-oxide of nitrogen resisted all his experiments. M. Cailletet, a distinguished chemist, has succeeded in liquefying bi-oxide of nitrogen by a new process. In a gas, the constituent atoms are wide apart; in a liquid, not so much; and least of all, in a solid. To liquefy a gas the atoms must be brought nearer to each other, then compressed, and next congealed. Cold is the most energetic of these reducing agents. After compressing a gas by means of a hydraulic pump, M. Cailletet liquefied it afterwards with the ordinary freezing mixtures. When the pressure is suddenly removed, the gas expands, and as is well known, the act of expansion produces a diminished temperature. The experimenter has demonstrated, what others have suspected, that there is a "critical point" of temperature, above which no gas can be liquefied. The practical applications of the beautiful discovery made by M. Cailletet can be immense. He has liquefied carburet of hydrogen, consisting of two elements, carbon and hydrogen. Now if he could obtain the carbon in a crystallized form, that would be the diamond.

M. de Chancourtois, an eminent engineer, lately asked if the diamond was not produced by a reaction, similar to that which engenders sulphur in certain localities where sulphuretted hydrogen, escaping from the fissures, the hydrogen unites with the oxygen of the air and forms water, the sulphur being deposited in the state of crystal. Replace the sulphurous by emanations of carbon, and the latter may be also deposited in a crystallized form. Where diamonds are most found, is exactly in that geological period—the Devonian, remarkable for bituminous impregnations, thus marking the intensity of carbon emanations. This negative solution in favor of the manufacture of diamonds is valuable.

So great is the inattention to the proper fitting up of school-rooms, that the wonder is, so many persons escape being hunchbacked or shortsighted. The seats and desks are generally of a uniform pattern for large as for small boys, deforming thus the vertebral column, and the lighting is so defective that 22 per cent. of the pupils, of French primary schools especially, are shortsighted, and this affliction becomes more pronounced the longer lads remain at school, that is to say, pass to the secondary schools or colleges.

Messrs. Trèlat and Gariel advocate that school-rooms should be lighted "bi-laterally," not from the centre, and thus flood the eye completely with light —incompleteness in this respect producing nearsightedness. Michelet, though poetically, has not the less accurately observed; the eye is a human flower, which has want of sun-light, as other flowers, to prevent etiolation and languishing. M. Dally, on the subject of the physiological aspects of education, asks, Are we right to have a common dietary for children of the establishment, when some of them have a predisposition for certain diseases that an appropriate regimen could prevent? He also disapproves of those systems of education, which replace, at the commencement of the child's cerebral life, impressions, sensations and object lessons for the abstractions of grammar, dead languages, &c.

The influence of colored light on plants and animals has lately occupied much atteution. It is difficalt at first to comprehend how the action of light can affect an invalid. M. Fano states that he has completely cured persistent headache by his patient employing yellow glass spectacles. The afflicted on attempting to read or write only augmented the headache, yet as some kinds of intellectual work did not produce fatigue, M. Fano concluded that the pain arose from the action of the retina on a morbid state of the nervous centres. He decided to change the conditions of perception for the retina, by no longer exciting it by the ordinary rays; he employed glass to produce only yellow rays; the pain diminished, and by continuing the same glasses, ultimately disappeared. M. Fano also obtained satisfactory results in certain cases, by the use of red, violet and other colored glass one person being sensible to blue, another to rose, following constitution. There are harmonies which delight the ear, why not colors to charm the eye, and calm also its nervous system?

Science, in point of novelties, keeps up with the spirit of the age. We have had hygrometric or barometric flowers, which changed color, following the humidity or dryness of the air; at present we have luminous flowers, that it suffices only to expose to the sun, to observe them afterwards becoming phosphorescent iu obscurity. The flowers are prepared with sulphurets of calcium, strontium, &c., compounds known as artificial phosphorus. Messrs. Dagron and Gisclon have produced "sympathetic pipes." They can "color" a meerschaum the most beautiful chocolate in five minutes by tinting the bowl with a solution of ether and alcohol, to which essence of roses, camphor, nitrate of silver, &c., are joined, so that any image or superscription painted on the pipe will gradually come out, like the impression of a photograph, under the influence of the light or the heat of the pipe. You can have your own portrait, or that of a friend, your dog or horse sketched on the pipe, as the likeness will appear on exposure to the air. It is well to remember, the metamorphosis once accomplished, is permanent.

Lavoisier demonstrated that a diamond consisted only of carbon, by changing it into carbonic acid. Messrs. Fremy and Feil are more commercially happy, in producing rubies, sapphires and corundums, which, like amethyst, emery and adamantine spar, are but varieties of alumina. Artificial rubies had been previously prepared, but only in the form of something like dust; albite and other varieties of feldspar have also been artificially prepared. The processes consist in subjecting a mixture of alumina, an alkali, an acid and a coloring matter to an intense heat during three weeks. This great temperature is but a tiny sample, at best, of that gigantic furnace—the earth's central heat, which melts, solders and petrifies rocks, to project through fissures to the surface. Is the discovery of Messrs. Fremy and Feil the philosopher's stone? They have produced specimens of rubies and sapphires, sufficient to satisfy watchmakers and jewelers, who declare the artificial to be superior to the natural gems. The base of the former is alumina, and when it is submitted along with its compounds to a long and intense furnace heat, it crystallizes; the crystals will scratch quartz, and the rubies, when subsequently heated, will lose their color, re-acquiring it, however, on cooling, as is the case with the natural precious stone. Rock crystal, agate and jasper are only oxides of a metal called silicum, but it is still crystallized silica; rubies, sapphires, &c., are but oxides of the metal aluminum, or clay, but this clay is crystallized. All the difference thus resides in the arrangement of the constituent atoms. Precious stones are but crystallized pebbles. There is a strong tendency in France to prosecute investigations respecting the combinations of minerals.

By means of a recent discovery of the valuable properties of the Brazilian plant jaborandi, the most refractory constitution can be made to transpire a quart of perspiration in the space of an hour. But what is not the less remarkable, another medicament, sulphate of atropine, can prevent that transpiration. Strange results from two drugs successively administered. If when the beads of perspiration are rolling most profusely, a dose of the atropine be administered, these beads will be stopped as if by enchantment and so well that if the individual were to enter a Turkish or vapor bath the skin would remain perfectly dry. The atropine is administered in very small doses, as a pill, and with great prudence. In pulmonary consumption, for example, the importance of this drug in checking night perspiration, is incalculable.

The wine merchants of Paris appointed a committee of practical and scientific judges to examine if salicylic acid, an excellent antiseptic, could preserve wine from fermenting, &c., without altering its taste or quality. The fact is, we know very little that is certain about this acid. The report states that the acid acts differently, following the origin, strength and manner in which the wine is conserved, if in bottle or wood. In the case of the thin wines of the centre of France, it alters them profoundly, and renders them disagreeable to the taste. It has no favorable action on red wines, and the good it has been said to effect in white wines is but small. It is not within the province of "industry" to ameliorate wines; the beneficial change must be looked for in a superior selection of vines, appropriate soil, careful cultivation and skillful processes of vinification.

The Greeks dedicated the grasshopper to Apollo, as the type of bad poetry, and the swan as the symbol of melody. Prof. Carlet, of Grenoble, has examined the "grasshopper's song:" it consists of a "drum" apparatus, beneath the second ring of the stomach, (and inside,) over which muscles internally stretch, and when contracting, form the "sticks" that beat. The professor has successfully modeled an apparatus, which "sings" very well.

F. C.

SCIENTIFIC MISCELLANY.

*ASTRONOMICAL NOTES.—MARS.

BY PROF. C. W. PRITCHETT.

In continuation of my note on Mars, of last month, it is befitting the time and subject to recur to Prof. Asaph Hall's recent investigation of the position of the south Polar spot on that planet. He has not only achieved enduring and world-wide distinction by the discovery of those unique satellites which for so many ages have eluded all the efforts of human vision, but contemporaneously, has conducted this investigation, requiring at once great skill in observing and rare mathematical ability in combining and applying observations. True, investigation so continuous and pains-taking, does not attract the attention and elicit the wonder of mankind, as does the discovery of systems hitherto unknown, yet its value to science must not be depreciated.

From the time of Sir William Herschel it has been known that this celebrated land mark on Mars was not coincident with the true pole of the planet; and yet the north polar spot of Mars has been found both by Mädler and Father Secchi to be coincident with his true north pole. Granting the spots to be vast accumulations of ice and snow, we have here an anomaly—something very unlike the phenomena of our own planet. On the earth, it is true the poles of cold do not coincide with the poles of rotation, yet the poles of cold are opposite to each other, and symmetrically situated with respect to the earth's pole. From observations made during August, September and October, Prof. H. deduced 34 equations of condition, which, combined by the method of least squares, gave three normal equations, and from these was deduced a new angular value, for the centre of the south polar spot, as measured from the true pole. It is interesting to

* Received too late for insertion under proper heading.

compare this result with the work of other celebrated astronomers. I copy them from the paper of Prof. H. in Ast. Nach., No. 2,174. The letter V denotes the angular distance of the centre of the spot from the south pole of Mars.

Herschel	1783, v=	8. 8°	Linseer	1862, v=	20.10°
Bessel	1830, v=	8. 6	Kaiser	1862, v=	4.16
Beer and Mädler,	1837, v=	12. 0	Hall	1877, v=	5.11
Secchi	1857, v=	17.42			

The anomaly above mentioned, with other reasons, has led some astronomers of late to question the long admitted theory that the spots are accumulations of snow and ice. At the meeting of the Royal Astronomical Society, of London, Nov. 9, 1877, a paper was read by Mr. Brett, tending to show that the received hypothesis of similarity in physical conditions between the earth and Mars is utterly untenable. The fundamental fact on which he reasons is the alleged absence of clouds in the envelope of the planet. He also asserted that the spot was not continuous with the surface of the planet, but lay far above it. This he concludes because no dark patch on the planet ever reaches to the limb, while the white south polar spot protruded beyond it. He suggested that the south polar spot is a permanent cloud, and the only real cloud in Mars. Prof. Hall's observations, however, made on the clearest nights and with the largest refractor now in use, seem to indicate very distinct markings or notches on the edge of the spot, and that it is really a depression in the surface of the planet. The hypothesis of a depression in the surface at once rids us of the anomaly of eccentric poles of cold, and seems more reasonable than that of one solitary and permanent cloud in the upper atmosphere of the planet.

I am gratified to add that Prof. Hall has received from the Academy of Sciences, Paris, the celebrated Lalando prize. No better evidence could possibly be afforded of the high estimate placed on his discovery of the Mars moons. It is the judgment of the successors of such men as Lalando, Laplace, Delambre and Leverrier.

I am privately informed that Prof. Hall has selected for the new satellites names, significant at once of their attendance on Mars and of their rapid rotation. The outer satellite is to be named Deimos, and the inner one Phobos. These personations of terror and fear, in the mythology of Homer and Hesiod, are always represented as attendant on Mars, (Ares in German) the god of desolation and war—sometimes they are mentioned as his sons, at other times as his charioteers, and even as his fiery steeds. In Homer, Phobos personified, means *flight*, the resultant of Deimos *terror*. So Liddell and Scott, and so Pope has it.

Iliad, Book XV, line 119:

> "With that he gives command to Fear and Flight,
> To join his rapid coursers for the fight;
> Then, grim in arms, with hasty vengeance flies,—
> Arms that reflect a radiance thro' the skies."

Also, Iliad, Book IV, line 440:

"These Mars incites, and those Minerva fires
Pale Flight around and dreadful Terror reign,
And Discord, raging, bathes the purple plain."

"Flight" is surely an appropriate name for the inner satellite of Mars, which revolves around its primary more than three times in one of our days. Prof. Hall is this winter engaged in a full discussion of all the observations on the Mars moons. The results will no doubt be given to the astronomical journals in due time. The major part of his observations on these satellites were published in Ast. Nach., No. 2,161. Our observations on them at this Observatory were published in Ast. Nach., No. 2,172. From notes accompanying the observations, it may be seen that on September 7th we were able to see both satellites with the planet in the field. Usually the planet was shut out of the field; and on one occasion the inner satellite was measured, when only 7.6″ distant from the disc of Mars.

MORRISON OBSERVATORY, FEBRUARY 12, 1878.

AMERICAN EXHIBITS AT THE PARIS EXHIBITION.

The rapid approach of the time fixed for the opening of the Paris Exhibition of 1878, renders it incumbent on us to remind those of our readers who intend to take action in this connection, that they should enter at once upon the preparation of their exhibits, so as to send in applications for space as soon as the commission shall have been appointed by our government.

It is of very great importance to this country that our inventors and manufacturers should be well represented in Paris next year. The French have an idea that this is a country of inventors and mechanics, but are entirely ignorant as to the specialties in which we excel. We should show this to them through the medium now offered us at the expense of both governments. There will undoubtedly in the future be a considerable market for our productions in Europe. Among the many subjects which should be exhibited in Paris are the following:

Special processes for the treatment of ores for the extraction of the precious metals; all kinds of machinery used in mining, milling, and concentration of ores, such as hoisting and pumping engines, ventilators, rock drills, ore dressing machinery, smelting, roasting and chloridizing furnaces, hotblast arrangements, Bessemer and Siemens-Martin plant, etc.; wire ropes, rope tramways, iron bridges, in which our engineers excel; engineer's instruments, mineral samples and products, manufacturing and agricultural machinery and products.

Though the time is exceedingly short, it is sufficient, with the characteristic energy of our people, to make our exhibit creditable if suitable measures be immediately undertaken.

The Paris Exhibition is national and under the entire control of the government. Space, steam power, gas and water, are given free. Goods, products or inventions entering the Exhibition grounds are protected upon the simple application for a certificate, delivered gratuitously, and the said certificate is good for three months after the close of the Exhibition, and without prejudice to the patent. All goods exhibited and sold shall pay only the duty according to the tariffs of the most favored nation. This is the best opportunity that can be offered to American manufacturers to learn how they can compete with other nations in foreign markets.

Messrs. Haight Bros. & Co., of 25 Pine street, New York, offer to attend to American exhibits at the Exhibition, and, having in their partner, M. Chantal, a gentleman long connected with French-American affairs in Paris, will, we have no doubt, do so with entire satisfaction to those who intrust them with their business; they can also furnish any information which proposing exhibitors may desire.—*Engineering and Mining Journal.*

MAINTENANCE OF THE PAVEMENTS IN PARIS.

For cleaning streets, machine sweepers are employed drawn by a single horse, cleaning about 5,000 square meters an hour.

The cost of keeping in repair is quite different for the different avenues; For the Rue Lafayette it is 16.08 francs.

The asphalt roadways have a joint area of 225,120 square meters, to which should be added about 34,000 square meters for the walks through the Macadamized streets. The price of construction varies from twelve to fifteen francs per square meter.

The repairing is done by contract for 1.10 francs per square meter per year for the roadways, and 1.70 francs for the walks.

The mean cost of repairing roadways in Paris, which was 1.08 francs in 1870, has been reduced to 0.82 francs. This reduction is due especially to a change in many places from Macadam to paved roadways. The mean cost of repairing pavement never exceeds 0.60 franc, while Macadam roadways cost 1.80 francs per square meter. The latter should therefore be replaced, except where they serve as promenades and ornaments, as in the boulevards and avenues.

The following estimates are extracted from a recent report to the Municipal Council of Paris by M. Watel.

The number of vehicles which pass daily through some of the principal thoroughfares of the city have been ascertained to be as follows:

Boulevard de Sebastopol	11,602
Avenue des Champs Elysees	11,734
Rue de Rivoli	13,898
Rue Royale	16,117
Boulevard des Capucines	19,043

The paved roadways have an aggregate total area of 5,458,000 square meters; their maintenance requires the constant service of 431 men (*cantonniers*). The cost per square meter varies from 15.90 francs to 20.40 francs according to the gauge (.10 to .16 meter).

The cost of hand labor in keeping the pavements in order is 0.154 francs per square meter.

The Macadamized roadways cover an area which, although less than in 1870, is still 1,900,000 square meters. The number of *cantonniers* required for their maintenance is 965.

The steam rollers employed weigh about thirty tons each. The rolling is generally completed in a single night.—*Van Nostrand's Magazine.*

KANSAS WEATHER REPORT FOR JANUARY, 1878.

PREPARED BY PROF. F. H. SNOW, OF THE STATE UNIVERSITY.

STATION.—Lawrence, Kansas; latitude, 38°, 57′, 25″; longitude, 95°, 16′; elevation of barometer and thermometer, 875 feet above the sea level, and five feet above the ground; rain gauge on the ground: anomemeter, 105 feet above ground, on the dome of the University building, 1,200 feet above the sea level.

The month was remarkable for its high temperature and large rainfall.

Mean temperature, 33°.97, which is 8°.04 above the January average of the ten preceding years. January, 1876, however, was slightly warmer, having a mean of 34°.70. The highest temperature was 55°, on the 24th; the lowest was 7°.5 on the 6th, giving a monthly range of 47°.5. This is a very limited range, indicating unusual uniformity of temperature. The mean at 7 A. M. was 38°.30; at 2 P. M., 40°.53; at 9 P. M., 33°.56. There were 22 days during the month whose mean temperature was above freezing point. The mercury has not reached the zero point during the winter.

Rain, 3.05 inches, which is 1.85 inches above the January average. Either rain or snow fell on nine days. There were flurries of snow on the 8th and 13th, not enough for measurement. There was a brisk thunder shower on the 26th, with hail and sharp lightning. The entire depth of snow for the winter thus far has been half an inch.

Mean cloudiness, 46.77 per cent., the month being 1.49 per cent. clearer than usual. The number of clear days was 14 (entirely clear, 9; half-clear, 9; cloudy, 8 (entirely cloudy, 8). Mean cloudiness at 7 A. M., 53.22 per cent.; at 2 P. M., 47.42 per cent.; at 9 P. M., 39.68 per cent.

Wind—N. W., 43 times; S. W., 24 times; N. E, 17 times; S. E., 5 times; E., twice; N., once; W., once. The entire distance traveled by the wind was 9,996 miles, which gives a mean daily velocity of 322.45 miles, and a mean hourly velocity of 13.43 miles. The highest velocity was 40 miles an hour from 2 to 3 P. M. on the 5th.

Mean height of barometer, 29.144 inches; at 7 A. M., 29.158 in.; at 2 P. M., 29.120 in.; at 9 P. M., 29.151 in.; maximum, 29.618 in., on the 6th; minimum, 28.835 in., on the 11th.; monthly range, 0.783 in.

Relative humidity—Mean for the month, 73.4; at 7 A. M., 82.4; at 2 P. M., 57.3; at 9 P. M., 80.2. Greatest, 94.7 on the 13th; least, 37.4 on the 23d. There was no fog.

BOOK REVIEWS.

BRYANT'S POPULAR HISTORY OF THE UNITED STATES. Vol. I. pp. 638, large octavo. Scribner, Armstrong & Co., New York: 1877.

This work has been called forth by the very evident want of a history of the United States intermediate between those prepared for schools and those which are too voluminous for general use; one which would combine an attractive style with a complete and authentic record of events. Perhaps no man in this country could have been selected who is better adapted to this work than the veteran writer and scholar, William Cullen Bryant. Having lived in and through the earlier days of our history, during the administrations of Jefferson, Adams and Jackson, and while Webster and Clay were leaders of American politics, and having published for a half century one of the leading metropolitan newspapers, he has necessarily been more or less intimately acquainted with most of the stirring events of the times, past as well as present, and is thus enabled to write with a confidence, freshness and accuracy unequalled by those historians who compile their facts from extraneous sources.

His coadjutor, Mr. Sidney Howard Gay, also an editor of long experiis noted for his knowledge of American history, elegant style and accuracy in details.

Between the two, it is not strange that an excellent and most readable history has been produced, adapted equally to the wants of the scholar and the tastes of the masses of readers. The volume now ready, is made up of the period extending from the first discovery of the Western Hemisphere to the establishment of the several colonies along the Atlantic coast and the beginning of their colonial career.

The chapters on Pre-historic Man, the Mound Builders, the Northmen in America, and the Pre-Columbian Voyages of Discovery, are extremely interesting, as well as novel and out of the usual course in historical works on the United States.

The illustrations, numbering some 320, are first-class, from the beautifully engraved portrait of Bryant himself, to that depicting the trial of Mrs. Hutchinson in Massachusetts (1657) for preaching strange doctrines in public.

The mechanical work is fully up to the standard of the well-known publishers, and will compare favorably with that of any other house in the country. The complete work will comprise four volumes. It is sold only by subscription, and Mr. A. Hart, the agent for this portion of the West, is meeting with satisfactory encouragement.

WORDS: THEIR USE AND ABUSE, by Professor William Matthews, L. L. D. Chicago: S. C. Griggs & Co.; 1877. pp. 384. Sold by Matt Foster. $2.00.

Professor Matthews is one of those rare writers, who can in all instances combine the useful and the elegant in such proper proportions as to exactly hit the popular fancy and taste. After publishing a half dozen volumes, all diverse in subject, yet alike in popular treatment, he remains in demand by the best readers, and his new work on Oratory and Orators will be sought for with as much avidity and read with as keen a relish as any of those that have preceded it.

The present work is devoted to the consideration of the significance, use and abuse of words under various headings, such as The Morality in Words, The Secret of Apt Words, The Fallacies in Words, The Common Improprieties of Speech, etc., etc., all of which are treated in an attractive and practical manner, well adapted to make a lasting impression upon the reader's mind.

His illustrations of the derivations of certain words and phrases are most copious and interesting—this chapter alone being well worth the price of the book. Few politicians are aware that the term "caucus," so often used by them, is derived from *Cawcawas*, a council-board among the Checahamania Indians; not all teachers know and practice upon the knowledge that "education" is derived from *educare* and not from *educere*; few christians are aware that the Bacchanalian exclamation "hip, hip, hurrah!" is made up from the first letters of the words *Hierosolyma est perdita!* being originally a war-cry adopted by the stormers of a German town, in putting the vanquished Jews to the sword; and not many Londoners will be willing to give up the story of Whittington and his cat for one which converts the *cat* into the French *achat* or *acat*, simply meaning trade or barter.

In some of these exercises the Doctor's derivations seem pretty far-fetched and the words capable of easier explanations. For instance he expends a page in tracing the expression of "apple-pie order" to its origin, and finally concludes that it is derived from *chapel* (printing office) *pie order*, which is either good order or disorder, as the case may be; when it would be quite as easy and equally plausible to attribute it to a slight misapplication and mispronunciation of the French "cap a pie." He also errs occasionally in the spelling of a word used as an illustration, as for instance, *carryvan* for *caravan*, *megalosaurius* for *megalosaurus*, but such things are very rare, and we conclude as we began, with saying that it is a most entertaining, useful and instructive work.

As is the case with all of S. C. Griggs & Co's publications, the typography, paper and binding are of the best quality.

THE PRICE CURRENT ANNUAL REVIEW; 1877. This is an exhaustive and comprehensive exhibit of the business of Kansas City for the year 1877; one which reflects equal credit upon the city and upon Messrs. Hasbrook & Simmons, who have devoted so much time and pains to its compilation.

PROCEEDINGS OF THE POUGHKEEPSIE SOCIETY OF NATURAL SCIENCES. Vol. I, Part I: 1875.

The Poughkeepsie Society of Natural Science was organized September, 1874, and this volume contains a selection from the various papers read before it during the first year of its existence The work done makes a very creditable showing, and these papers will compare favorably with those of much older societies. Two of the contributions, one on "Insects as an Article of Food," and the other on "Fungus Eating," are very interesting, to the general reader as well as the scientist. The Proceedings are gotten up in good style, with illustrations to some of the papers. The Society is composed of excellent material, having a good corps of working members, who aim at a high standard of excellence in all that they do.

EDITORIAL NOTES.

THIS NUMBER completes the first volume of the REVIEW, and upon looking over the year's work, we are tolerably well satisfied with it. Our effort at all times has been to make it an acceptable visitor to all classes of readers, and with this in view we have been compelled to procure our articles from a large number of sources. Fortunately our contributors have used their talents upon diverse subjects, and our exchanges comprise periodicals, both English and American, devoted to almost every branch of science, so that our task has been comparatively easy, after all.

It is a matter of pride to us that so many of the distinguished scientific men of the West have deemed the REVIEW a suitable medium for placing their ideas, theories, records and discoveries before the reading public, and we have assurances that there will be no falling off in this respect in the future.

We have given our readers seven hundred and sixty-eight pages of well printed, substantial and reliable reading matter, comprising original articles by more than twenty able writers, and selected from a list of over fifty of the best scientific, medical, educational, agricultural and literary periodicals in the world, and have distributed for our advertisers twelve thousand copies of the REVIEW in more than half of the States of the Union, but principally in Missouri, Kansas and Colorado, where it has reached not less than four or five times as many readers.

The REVIEW has been warmly welcomed by the press of the country, both scientific and literary, and has been quite as well patronized, especially in Kansas City, as could possibly have been expected, considering that it is the first publication of the kind which has ever been started in the West. Another year we shall hope to improve it in several respects, still, however, only attempting to adapt it to the popular rather than to the strictly scientific taste. We shall also hope for an increased support, both at home and from a distance.

In fact, the only thing now wanting to make the REVIEW a permanent publication is more subscribers and a few more advertisements. We feel that we ought to have both; not as a gratuity, however, but because our periodical is worthy of them, and will repay both as a business investment.

THE KANSAS CITY ACADEMY OF SCIENCE met at its rooms on the evening of January 29th, and notwithstanding the disagreeable weather there was a full attendance. Before the commencement of the regular exercises, those present availed themselves of the opportunity to inspect the fine collection of stuffed birds prepared and presented by Mr. Frank Devens.

At eight o'clock Judge West called the meeting to order, and Col. Van Horn proceeded to read his paper upon "The Atmosphere and its Phenomena." As the article is printed in full in this number of the REVIEW, it is unnecessary for us to say more than that the essayist's views are clearly stated, his statements fully supported by facts, his premises so laid down as to legitimately and logically lead to his conclusions, and that the paper was listened to with marked interest from beginning to end. None which has been presented to the Academy has elicited more discussion or called forth more or warmer complimentary comments.

At the close of Col. Van Horn's paper one by Prof. G. C. Broadhead, upon "Meteors and Meteorites," was read. It, also, is printed in full in this number of the REVIEW. It will be found a full, complete and accurate account, and one which will be extremely interesting to meteorologists and others.

PROF. KEDZIE places us under obligations by sending us copies of the original announcements by MM. Pictet and Cailletet of their success in liquefying oxygen, hydrogen and nitrogen, gases which have hitherto resisted and been supposed incapable of being reduced to solid forms.

WE are compelled to apologize for the extremely unartistic appearance of the cuts illustrating Prof. Pritchett's astronomical article. They reached us too late to have the damages repaired, and we were obliged to use them, bad as they are, or leave them out altogether.

AS WE have stated before, we can club the REVIEW with any of the Literary or Scientific Magazines of the country, so as to save to subscribers one dollar or more on the two periodicals.

SUBSCRIBERS who have not received all of the numbers of the REVIEW for the past year will be supplied with those missing *gratis* upon calling upon the editor. All others wishing back numbers will be supplied at twenty cents each.

WE have made arrangements for binding the first volume of the REVIEW in half morocco, with cloth sides, at $1.00 per volume, if ten or more volumes are sent in at one time. Persons at a distance will have to send 28 cents in addition to the above sum to cover return postage, unless they find that express charges will be less.

CLEOPATRA'S NEEDLE has at last been safely delivered at London, and the caisson containing it is now safely moored in docks furnished by a liberal mercantile firm of the city.

TO ALL new subscribers to the REVIEW for the next year we will furnish a bound copy of the first volume at the reduced price of $3.00.

NOTICES OF PUBLICATIONS RECEIVED.

WE are much gratified at being able to number among our exchanges the following valuable and popular periodicals, which have been added to our list within the past month:—

THE ATLANTIC MONTHLY, a veteran among the literary magazines of this country, being in its forty-first volume, and having maintained during all that time an unsurpassed reputation for furnishing its readers excellent as well as elegant articles, whether in prose or verse, on all the topics of current literature, has added to its attractions by consolidating with itself the well-known and popular *Galaxy*. All of the old contributors to the *Atlantic*, such as Longfellow, Holmes, Howells, Aldrich, "Mark Twain," etc , will continue to enrich its pages, while most of those who gave to the *Galaxy* its freshness and sparkle will be retained and will lend their brilliancy to the survivor. Published by Houghton, Osgood & Co., Boston, Mass. $4.00 per annum. Single numbers, 35 cents.

THE INTERNATIONAL REVIEW. Vol. V., No. 1; January and February, 1878. Published by A. S. Barnes & Co., New York. $5.00 per annum; single numbers, $1.00. This periodical, though comparatively a new one, has rapidly assumed strength and position, and now stands among the foremost of the standard *Reviews* of the United States. The present number contains articles by such well known and able writers as Whittier, David A. Wells, Ernst Curtius, Edward A. Freeman, Major Ben. Perley Poore, Prof. W. C. Sumner, Alex. H. Stephens, and others, both in this country and Europe, equally noted as writers and thinkers.

The tone of the *International* is fresh and wholesome, and its choice of articles is characterized by a discriminating liberality and cosmopolitanism, making it strictly what it purports to be, a review of the international sentiment of the age in literature, science, politics and religion.

HARPER'S NEW MONTHLY MAGAZINE, for March, 1878. Harper & Brothers, New York. $4.00 per annum: single numbers, 35 cents. This, the most popular of all the illustrated monthlies, although in its fifty-sixth volume, still adhers to its original title of Harper's *New* Monthly, which is in truth most appropriate, for each number is a "new thing" and more attractive, if possible, than the one before it. Being one of the first of American magazines to adopt the illustrated style, it has kept it up ever since with increasing excellence, until now the engravings, both in the Monthly and the Weekly, are works of art worthy of preservation for their artistic merit aside from the value of the letter-press which they illustrate.

It is quite unnecessary to go into any extended notice of this periodical, as it is known in every corner of the United States, and is found in the cabin of the Colorado miner and of the Kansas ranch-man as universally as in the parlors of Eastern capitalists and *literati;* but to those who have not decided to renew their subscriptions for this year, we will say that its scientific articles are as ably written and illustrated, its historical, geographical and literary articles as attractive, its editorial notes as fresh and sparkling, its scientific record as full and complete and its Drawer as irresistably "funny" as ever, and that no magazine in the country excels it for family reading adapted to all classes, old and young, wise and simple.

THE LITERARY WORLD. Published monthly by E. H. Hames & Co., Boston. $1 50 per annum; 10 cents for single numbers. Vol. 8, No. 8. This periodical, like the *Library Table*, of New York, is devoted to descriptive notices and critical reviews of new publications, and a general review of literary matters of all kinds. It is admirably edited, and is regarded by all librarians as a most useful aid to them in purchasing books.

THE YOUNG SCIENTIST. Vol. 1, No. 1. Published monthly by the Industrial Publication Company, N. Y. 50c per annum; 6c for single numbers. This is a successor to the *Technologist*, and judging from the first number, which is made up of articles upon useful and popular subjects, it will be a valuable work for students and young scientists, for whom it is especially intended, as its title indicates.

THE AMERICAN BOOKSELLER. Vol. 5, No. 3. Published by the American News Company, N. Y. $1.00 per annum; 5c per single copy. This is a semi-monthly journal, devoted to the interests of the book, stationery, news and music trades, and contains copious criticisms and reviews of current literature, lists of new books, and a very complete monthly index of the principal articles in all the periodicals of the country. It is a most useful publication for all readers and students.

BISHOP MARVIN'S "To the East by Way of the West," Marvin's Lectures on the "Errors of the Papacy," and Rev. Eugene R. Hendrix's "Around the World," with introduction by Bishop Marvin; price of each book, $2.00. ☞ AGENTS WANTED everywhere. Send amount named to Logan D. Dameron, agent of the Advocate Publishing House, St. Louis, and get sample copies of either, or all three, with terms to agents. The books are selling rapidly. Some agents have sold 50 copies in a single day.

A VERY RARE and interesting fish, somewhat resembling the *Lepidosiren annectens*, was caught in the Kansas River recently. Unfortunately it was allowed to spoil, and was thrown away before its peculiarities were called to the attention of any one interested in such matters.

THE LEAVENWORTH TIMES advocates the selection of Fort Leavenworth reservation as the site for the new National Observatory. We know of no better location in the country, and hope that the choice may fall upon that beautiful and most eligible spot.
