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SCIENCE, MECHANIC ARTS AND LITERATURE.

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GEOGRAPHY.

EXPEDITIONS TO THE ARCTIC SEA.

We gladly give place to the following letter from Prof. John Rae, of London, correcting a few errors of statement in a former article on this subject.—[Ed.

The Editor of the Kansas City Review:—

Sir,—In looking over your Review of March, kindly sent me by a friend, I find a list—chronologically given—of the various national expeditions to the Polar Seas.

In this list there is one entry that was not a National expedition, one error of date, and three omissions, which perhaps you would allow me to point out—

The expedition under Captain (*not Lieutenant*) Back, in 1833, was got up by private subscription, aided by the government to the extent of not a third of the money required.

No expeditions were sent in 1847 by the British government to search for Sir John Franklin.

Sir John Richardson and Dr. Rae were sent by the British government overland in 1848 to the Arctic Sea, *via*. McKenzie River, and searched the coast eastward to the Coppermine River for Franklin. This was a costly expedition, as boats and men were sent from England via. Hudson's Bay.

In 1849 the British government sent Dr. Rae to the Arctic coast, by the Coppermine River, to search for Franklin.

In 1851 Dr. Rae was again employed by the British government to search for Franklin by the Coppermine River, during which a sledge journey of over a thousand miles was made at the average rate of about twenty-five miles a day; the fastest time on record, considering that both officer and men were *hauling sledges* or carrying loads all the time. On this journey and the subsequent boat voyage, about seven hundred miles of unknown coast line of Wollaston and Victoria lands were traced, and *Victoria Strait* discovered and named, remarkable for being the channel in which the crews of the Franklin Expedition abandoned their ships in 1848. Rae's boats coming from the South, having reached a point on the west shore of the strait in a higher latitude than that where the ships were left, formed a last link in the Northwest passage.

These three expeditions were wholly paid for by the British government, and therefore should be included in the chronological list referred to.

Yours, &c.,

JOHN RAE.

HONORS TO NORDENSKJOLD.

The Swedish government has resolved to award a national testimonial to the members of the Expedition under Professor Nordenskjold's direction. The testimonial is not intended for the officers and scientists of the Expedition alone, but for all the men who shared in its dangers and discoveries. King Oscar gives to each man a medal bearing on one side the head of the Sovereign with the inscription, "Oscar II, King of Sweden and Norway," and on the other the insignia of the order of the Northern Star, with the legend "For having opened a route in the Glacial Arctic Ocean, 1878–1879." Fifty copies of this medal will be struck off—four of them in gold and the remainder in silver.

Nordenskjold reached Paris April 2, accompanied by Captain Pallander, the sharer of his adventures in the North. They were received at the railway station by delegates of the various scientific societies—M. Grandidier, president, and M. Maunoir, secretary of the Geographical society; M. Siebbern, Swedish Ambassador, with several attachès; M. Rabaud, representing the Societè de Marseilles; M. Meyners d'Estreye, President of the Societè Indo-Chinoise; Dr. Crevaux, the young explorer of French Guiana; a deputation of Swedish residents and a few journalists, including your correspondent Nordenskjold looked the very picture of health and seemed vigorous enough for a dozen Arctic expeditions. He was dressed with the utmost simplicity in a light traveling suit. Captain Pallander appeared to be very much embarrassed in the attire of a private gentleman, being so long accustomed to his naval uniform. M. Grandidier said that he was happy to meet such a distinguished visitor and bade him welcome in the name of the geographical societies of Paris and the Departments and of the scientific societies of France. A banquet was given them on the night of April 4th, by the members of the Swedish Colony in Paris. Upward of two hundred gentlemen and ladies of Swedish nationality were present. But few invitations to foreigners were issued, and these merely to the press. The grand saloon of the Continental Hotel was tastefully arranged for the occasion, one of the decorations being a carved prow of the Vega, surmounted by a bust of Nordenskjold, by Runeberg, son of the great Swedish poet. This was projected in the center of the hall. On the columns of the room were escutcheons bearing the names of great Swedish explorers of old as well of those who had taken part in the Nordenskjold Expedition. At the central table was seated Prince Oscar, and among the principal persons present were the Swedish Ambassador, the Swedish Consul General Moltke, the Danish Ambassador, the Consul General of Spain, Colonel Staafe, military attachè; Christine Nilsson, the singer, and M. Rouzeaud, her husband. The Swedish Minister proposed Nordenskjold's health, and the explorer replied in Swedish, but with a strong Finnish accent. He modestly said that the greatest pleasure which he derived from his success was that it all redounded to the honor of his country.

On the 5th of April Nordenskjold was formally received by the Municipal Council of Paris, at the Pavillon de Flore, in the Tuilleries. Neat complimentary addresses of welcome having been read by the President of the Council and M. Ferdinand Herold, Prèfet of the Seine, who represented the government, Nordenskjold was then presented with a handsome gold medal commemorative of his expedition and of his visit to Paris. Its value was some $300.00. The explorer acknowledged the compliment in modest phrase, and the ceremony was ended by the President gracefully thanking the French and foreign press for their attendance. The hall was tastefully decorated with flags. The Municipal Guards, in full uniform, lined the staircase.

A NEW POLAR EXPEDITION.

The *Presse*, of Vienna, announces that Capt. Weyprecht, of the Austrian Navy, in concert with Count Wilczek, is completing arrangements for another expedition toward the North Pole at an early date. This time Capt. Weyprecht will not be accompanied by any of the intrepid companions of his former voyages, as it appears they prefer rest at home to the adventures and dangers of the hyperborean seas.

THE NORDENSKJOLD AFLOAT.

The Calcutta *Englishman* reports that the Swedish steamer A. E. Nordenskjold, which was sent out in June last in search of Nordenskjold's Expedition and went ashore two months later on the Japanese island, Jesso, has been got off safely. M. Sibiriakoff, who commanded her, will attempt to return home westward round the north coast of Asia, from Behring's Strait to Spitzbergen, on the route which Nordenskjold took when going eastward in the Vega. [The rescued craft, though small, being 340 tons burden and sixty horse-power, is admirably calculated to resist the rigors of Arctic navigation, a resistance that has been proved by her successful weathering of a severe winter in the inhospitable region of Jesso.] Her small size will be rather an advantage than otherwise in the difficult route M.

Sibiriakoff has proposed to follow. The Nordenskjold was built at Malmo, Sweden, for the express purpose of going to the assistance of the explorer, whose whereabouts were then unknown. She was launched on April 23, 1879, and left Malta on June 3 for Behring's Strait by way of the Suez Canal. She was to pass through Behring's Strait and thence direct her course to the mouth of the Lena. On August 4 the vessel left Yokohama and proceeded on her way north. At the time the Nordenskjold started it was considered that the Vega was beset in the ice some forty miles northwestward of East Cape at Behring's Strait, and at a considerable distance from any settlement. The Nordenskjold was to seek the missing vessel there. When the fate of Professor Nordenskjold and his expedition were still undecided and grave fears were entertained for his safety, M. Sibiriakoff, a warm friend and supporter of the explorer, was the first to take practical measures for his relief and his steamer was the first fitted out for the purpose, he bearing all the expenses of the expedition. Not content with fitting out a steamer of his own, he made earnest appeals for assistance in all quarters where it was likely to be given.

ASTRONOMY.

A NEW DETERMINATION OF THE DIAMETER OF MARS.

H. S. PRITCHETT, ASTRONOMER MORRISON OBSERVATORY.

During the near approach of the planet Mars, in the recent opposition of 1879, the following careful observations of its diameter were made with the large Equatorial of the Morrison Observatory, partly with the purpose of testing the figure of the apparent disc, and partly to furnish an accurate measure with a filar micrometer for comparison with those obtained from the heliometer. I have just finished a reduction and discussion of these measures, and the results given below represent an abstract of a more complete paper forwarded to the "*Astronomische Nachrichten.*" The observations were made by Prof. C. W. Pritchett.

While the measures of such an object as the disc of Mars with a filar micrometer, will never be entirely free from the effect of irradiation, and therefore will never give the true value of the diameter quite as accurately as the heliometer, still, in a telescope of such good definition as the one used, this effect would be very small. Filar micrometer determinations of the diameter are still further useful from the fact that they are to be used in the reduction of incomplete observations made with similar instruments, and for other common astronomical operations. For this reason the values of the diameters of planets used in computing their apparent discs for the *Nautical Almanac*, *Berliner Yahrbuch* and *American Ephemeris*, are derived from observations with a filar micrometer.

The discrepancy between these and the value obtained from the heliometer is shown in the following table. In the eolumn "Diameter" the angular value of the diameter for distance unity is given:

Value used in the Nautical Almanac and Berliner Yahrbuch,	11″.100
Value used in the American Ephemeris	10.108
Bessel's value from the Heliometer, ...	9.328
Hartwig's value from Heliometer observations of Bessel, Kaiser, Main and himself	9.352

The difference here shown between the largest and smallest values amounted to 4″ at the time of opposition. The value used in the *American Ephemeris* was derived from observations with the Mural Circle (aperture 4.1 in.) of the Naval Observatory during 1845-46, and is subject to the large probable error ±0″.203. In the observations made at this observatory the diameter of the disc was measured in four different directions:

1. From position angle 143° to 323°, corresponding to the polar diameter.
2. From position angle 8° to 188°.
3. From position angle 98° to 278°.
4. From position angle 53° to 233°, corresponding to the equatorial diameter.

The observations extended from October 27 to November 24, the opposition occurring on November 12, and the nearest approach of the planet to the earth on November 4. After correcting the separate observations for incomplete illumination and reducing to distance unity, the results of the measures are shown in the following table:

DIRECTION.	NO. OBSER'TION.	DIAMETER.	PROBABLE ERROR.
143°—323°	17	9″.422	± 0″.024
8°—188°	9	9 .489	± 0 .043
98°—278°	8	9 .517	± 0 .032
53°—233°	17	9 .638	± 0 .044

If these separate results are considered as independent measures of the same diameter, and combined according to the method of least squares, there will result finally, Diameter=9″.486±0″.033, which, combined with Newcomb's value of the solar parallax, gives for a mean value of the diameter of the planet 4248 miles, with a probable error of 15 miles. This value, as will be seen, agrees quite closely with the determinations of the heliometer, and shows conclusively that the values in use in the Ephemerides are much larger than would be given by any good instrument of good definition and moderate size.

The difference between the polar and equatorial diameters being so much greater than the probable error would indicate, seems to show an ellipticity of the apparent disc. This systematic difference was noted in the individual observations from day to day, and is confirmed by the measures of the intermediate diameters. The observations would then assign to the planet the form of an ellipsoid of revolution, with a polar diameter of 4220 miles and an equatorial diameter 4317, the amount of compression being 1-45. Very varying results have been arrived at for the amount of compression of Mars. Sir Wm. Herschel gives it 1-16; Schröeter less than 1-80; Arago, from Paris observations extending over 36 years, 1-30; Hind gives it 1-51; and Main 1-62. Bessel merely decided that it was too small for measurement with his heliometer. This discordance shows quite clearly the difficulty of measuring such a bright glowing disc as that of the planet Mars.

ENGINEERING.

COMPARATIVE MERITS OF WOOD, STONE AND ASPHALT PAVEMENTS.

GEN. Q. A. GILMORE, U. S. A.

Assuming the foundation to be firm and solid, so that ruts and depressions cannot form upon the surface except from actual wear, a pavement of stone blocks, of first quality as regards hardness and toughness, will possess the longest life of the three, and one of wood blocks the shortest; asphalt lies between the two and very near to the stone, and will fluctuate from this position with the amount and kind of traffic, and the influences of the climate. As a rule wood must be regarded as the least durable. When it begins to go—at the end of two or three years, under heavy traffic—it wears rapidly into deep and numerous ruts, by the crushing of the blocks to their entire depth. Unless the stone be of excellent quality for pavements, it takes the second place in the order of durability, and asphalt the first.

The absolute cost of constructing the different pavements will of course vary very considerably with the locality. It is believed, however that with few exceptions, the following order of cheapness will obtain throughout the United States: viz., first, wooden blocks; second, asphalt, on a solid cobble stone foundation; third, asphalt on a concrete foundation; fourth, stone blocks on a concrete foundation.

Under the head of cost and maintenance of repairs, the life or endurance is to be considered, and the total expense must extend over and cover a period of time representing that endurance, under the assumption that at the end of that period, the pavement is in as good a condition as at the beginning when it was new. The repairs for the first two or three years will be comparatively trifling, and in some cities, more especially in England, it is customary for the constructor to maintain the pavements in a good sound condition without charge for one, two and sometimes three years, and subsequently for a longer period, seldom exceeding fifteen years, for a specified sum per square yard per year.

With regard to wood and asphalt, the recorded observations make it certain that although a pavement of wooden blocks is less costly to construct than one of asphalt, not only is its annual cost for repairs greater, but its mean annual cost during its life, inclusive of the first cost, is also greater than that of asphalt. With regard to stone, there is a vast difference in the endurance of hard and tough basalt and trap, and the average granite and gneiss.

In economy of maintenance per year during the lifetime of a pavement, including its first cost, the hard basaltic trap rocks should be placed first, asphalt second and wood third, except in localities where wood is very cheap and suitable stone cannot be procured, or is subject to heavy charge for transportation. Under such circumstances stone would take the third place and wood would rise to the first. Where wood and stone are both expensive, or the latter is not of the best quality with respect to toughness, asphalt would take the first position.

Both mud and dust adhere with more. tenacity to wood than to asphalt or stone, more especially after the fibers of the former begin to crush and abrade, and the order of merit in respect of facility of cleansing, will be first, asphalt, second, stone, and third, wood, whether the cleansing be done by sweeping or by washing. It stands to reason that a smooth, even surface can be cleansed more rapidly than one cut up with numerous joints.

Mr. William Haywood, C. E., of London, in his report "as to the relative advantages of wood and asphalt for paving purposes," made to the Commissioners of sewers of the city of London, March 17th, 1874, says that "asphalt is the smoothest, dryest, cleanest, most pleasing to the eye, and most agreeable for general purposes, but wood is the most quiet." It might perhaps be better to say that the noise produced by wood is of a different kind, which may be more disagreeable to some persons and less so to others. Stone is the noisiest of all pavements.

The noise produced by wood is a constant rumble, that by asphalt an incessant clicking of the horses' feet upon the street surface, with scarcely any noise from the carriage wheels, while stone gives out a deafening din and rattle from feet and vehicle combined.

On the supposition that the surface is kept clean by either sweeping or washing, the difference in slipperiness between wood, stone that does not polish under wear, and asphalt, is not great, although enough, perhaps to place asphalt last; while a horse not only falls more frequently, but recovers himself less often and less easily upon it than upon the others, by reason of the joints in the latter, which give a foothold. When the surface is covered with mud, asphalt is the most slippery of the three, and very little mud makes it slippery. It cannot be said to be slippery when very dry, or, if free from mud, when very wet.

In times of snow there appears to be little if any difference in this respect between wood, asphalt and stone, but under a sharp dry frost, asphalt and stone are generally quite dry and safe, while wood retains moisture and is very slippery.

In the condition in which they are usually maintained, a slight rain adds to the slipperiness of each of these pavements, with this difference, that on asphalt and stone this state begins with the rain or very soon thereafter, while the worst condition of wood ensues later. It however lasts longer than upon the others on account of its absorbent nature. With regard, therefore, to the convenience and comfort of those using the street, as well as those living adjacent thereto, the weight of opinion appears to place asphalt first, wood second and stone third, for all streets except those habitually crowded with heavy traffic, in which case stone would rise to the first place and asphalt drop to the third.

A practical and general recognition of the fact—so well known in the medical profession, and indeed among all ranks of cultured people—that the pavements of a city exert a direct and powerful influence upon the health of its inhabitants, has never been secured. Most people claim simply that a street surface should be hard and smooth without being slippery, and, as a measure of economy, that it shall be durable and easily cleansed; but they go no further.

The advantages of noiselessness are recognized by many upon various grounds; by the large majority as simply conducive to comfort, but by few as conducive to health; while the kind of material used, provided it satisfies the foregoing conditions, and the character of the surface is satisfactory with regard to continuity and impermeability, is far too generally considered to be a matter of small moment.

The hygienic objections to granite, are first, its constant noise and din, and second its open joints which collect and retain the surface liquids, and throw off noxious vapors and filthy dust.

Dr. A. McLane Hamilton; Assistant Sanitary Inspector of the city of New York, in an official report dated October 19, 1874, says, "a quiet and noiseless street pavement would advance the health of the population to a great extent. The sufferer from nervous diseases would find relief from the noise of empty omnibuses and wagons rumbling or rattling on the rough stones, in the event of a removal of this nuisance. In fact there would be many more sanitary benefits resulting from a change than I can here detail."

It is not deemed necessary to enlarge further upon this point. The writings of eminent medical practitioners are full of testimony to the pernicious influence of street noise and din upon the health of the population, particularly upon invalids and persons with sensitive nerves.

The noisome and noxious exhalations emanating from the putrescent matter, such as horse dung and urine, collected and held in the joints of stone pavements, constitutes another sanitary objection to their use in populous towns. Exceptions to wood may be taken upon the same, and even upon stronger grounds, for the material itself undergoes inevitable, and, sometimes, even early and rapid decay, in the process of which the poisonous gases resulting from vegetable decomposition are thrown off.

The joints of a block pavement, whether of wood or stone, constitute, after enlargement by wear, fully one-third of its area, and under the average care, the surface of filth exposed to evaporation, covers fully three-fourths of the entire street. This foul organic matter, composed largely of the urine and excrement of different animals, is retained in the joints, ruts and gutters, where it undergoes putrefactive fermentation in warm, damp weather, and becomes the fruitful source of noxious effluvium. In dry weather this street soil floats in the atmosphere and penetrates the dwellings in the form of unwholesome dust, irritating to the eyes and poisonous to the organs of respiration. Its damage to furniture, though serious, is unimportant in this connection. In the side gutters and underlying soil the foul matter exists in a more concentrated form, the supply being constantly renewed from the crown of the street, and in many districts, from the filthy surface drainage of backways and alleys peopled by the poorer classes. Is it too much to say that under such circumstances the infant population, and especially the children of poor people, in large towns, can only be reared under such predispositions to disease as will constitutionally render them an easy prey to epidemics in maturer years?

The foregoing are some of the leading hygienic objections to pavements laid in blocks, whether of stone, wood or other material. There are others peculiar to wood alone, arising from its decay, its natural porosity, and the spongy character conferred upon it by wear and crushing.

"Impregnation of wood with mineral matters, to preserve it from decay, may diminish these evils, but nothing as yet tried prevents the fibers being separated, and the absorption of dung and putrescent matter by the wood being continued. The condition of absorbing mere moisture is of itself bad, but when the surface absorbs and retains putrescent matters it is highly noxious. The blocks of pavement with this material are separated by concussion, and are thus rendered permeable to the surface moisture. Mr. Sharp, who examined some blocks taken up for re-pavement, states that he found them perfectly stained and saturated with wet and urine at the lower portions, while the upper portions were dry. Mr. Elliott, a member of the society, and for many years a deputy of the Common Council of the city of London, has carefully observed the trials of new modes of pavement there, and objects to wood that it is continuously wet and damp. Wood is wet or damp, more or less, except during continued very dry weather. Its structure is admirably adapted to receive and hold, and then give off in evaporation, very foul matters, which taint the atmosphere and so far injure health." (Report of P. Le Neve Foster, Secretary Society for the Encouragement of Arts, Manufactures and Commerce: London, 1873.

Prof. Fonssagrives, of France, says: "The hygienist cannot, moreover, look favorably upon a street covering consisting of a porous substance capable of absorbing organic matter, and by its own decomposition giving rise to noxious miasma, which, proceeding from so large a surface, cannot be regarded as insignificant. I am convinced that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers."

The dust produced by the abrasion and wear of a wooden pavement is regarded by physicians as extremely irritating to the organs of respiration and to the eyes, and being light in weight it floats longer in the atmosphere and is carried to a greater distance, than that from any other suitable material in use for street pavements.

The evidence from a sanitarian point of view, against the use of wood for paving purposes in populous towns, is very strong, but the evils are not developed to the same extent in all localities. Decomposition begins in two or three years in clayey and retentive soils, while it is very considerably retarded and the wood remains habitually drier and emits less effluvia where the subsoil is sandy and porous.

The most characteristic features and properties of asphalt pavements have been briefly summarized and it is not deemed necessary to repeat or enlarge upon them here. Professor Fonssagrives remarks that, "The absence of dust, the abatement of noise, the omission of joints—permitting a complete impermeability and thus preventing the putrid infection of the subsoil—are among the precious benefits realized by asphalt streets."

Upon hygienic grounds, therefore, asphalt conspicuously stands first, stone second, and wood third in order of merit.

The correct inference from the foregoing discussion is that no one pavement combines all the qualities most desirable in a street surface. It cannot be sufficiently rough, or sufficiently soft, to give the animals a secure foothold, and at the same time possess that smoothness and hardness which is so essential to easy draught. The advantages of open joints and entire freedom from street filth cannot exist together, under any reasonably cheap method of cleansing the surface.

A pavement of impermeable blocks, if laid upon a solid foundation, may be constructed and maintained in a water tight condition, by thoroughly caulking the joints with suitable material, leaving the surface sufficiently rough and open to obviate the objection to a continuous monolithic covering, but roughness, combined with the requisite hardness, is incompatible with the freedom from noise attainable with some kinds of acceptable street surface.

In order, therefore, to obtain the best pavement for any given locality a judicious balancing of characteristic merits is generally necessary. The best pavement so far as we now know, for all the busiest streets of a populous city, where the traffic is dense, heavy and crowded, is one of rectangular stone blocks set on a foundation as good as concrete, or as rubble stone filled in with concrete; and the next best is one of Belgian blocks set in the same manner.

The best pavement for streets of ample width, upon which the daily traffic is not crowded, or for streets largely devoted to light traffic or pleasure driving, or lined on either side with residences, is continuous asphalt for all grades not steeper than 1 in 48 or 50.

If the blocks of compressed asphalt fulfill their present promise, they may be able to replace those of stone upon streets where the latter are now preferable to a sheet of asphalt on account of the steepness of the grade.

It has been urged, as an objection to a concrete foundation, that it is difficult to take up in order to reach the gas and water pipes. This is true only in the sense that good work is not easily taken to pieces. But such a foundation when torn up or deranged from any cause, can readily be restored to its former condition, and the pavement relaid upon it with all its original smoothness, firmness, and stability, conditions which do not obtain with any kind of pavement laid upon a bed of sand or gravel.—*Roads, Streets and Pavements.*

REMOVAL OF CLEOPATRA'S NEEDLE FROM EGYPT TO NEW YORK.

Through the skill of Lieutenant Commander Gorringe, of the United States Navy, backed by the splendid liberality of one of New York's citizens, Mr. W. H. Vanderbilt, who has borne the entire expense of the undertaking, the remaining "Cleopatra's Needle," which was presented some time ago by the Khedive of Egypt to the United States, has been finally safely lowered from its pedestal to the ground; and if no unforeseen accident should occur, may be expected to reach our shores in the early part of the coming summer.

Obelisks are the most simple monuments of Egyptian architecture, and among the most interesting that antiquity has transmitted to us, from the remoteness of their origin, and the doubt in which we still remain as to the period when set up. The oldest which now remains to us is still standing at Heliopolis, near Cairo—the On Ramses or Beth-Shemesh of the Hebrew Scriptures. Abraham was unborn, and the Pentateuch of Moses was unwritten when the inhabitant of Heliopolis adored his gods in the Temple of the Sun and read upon the obelisk, still in its place, the name of Harmachis and that of King Osortisen, who then reigned and reared it, and to whom Mariette Bey assigns the date of 2,851 years B. C. Pliny says that the Egyptian term for an obelisk conveyed the idea of a sun's ray, which its form was supposed to symbolize. The term obelisk is derived from the Greek *obelos*, which meant a "spit"—a term which the witty epigrammatics gave them, with the view, like all wits in such cases, to cover with an air of ridicule what they could not controvert by reason. Obelisks have, from the earliest periods of antiquity, been regarded as remarkable monuments of the skill and perseverance of remote ages. They must ever be considered as valuable records of the ancient history of the Egyptians, and of the skill of those periods; monumental evidences of their sovereigns and their warlike exploits. Extracted with vast labor from their quarries as monoliths, conveyed six or seven hundreds of miles down the Nile and erected with difficulty in front of their temples by kings to commemorate their victories and record their various names and titles, they are emblems of both the perseverance and love of glory of the Egyptians and their rulers. The very fact of their being transported to Europe by the ancient Romans under their emperors shows the high value in which they were held by that people, as witnesses of their own world-wide victories in remote regions.

The Egyptians set great value upon the size of their monoliths, and if a large block was extracted from a quarry not quite corresponding in all its sides, whether as to size or form, they would without scruple use it for their immediate purpose, or shape it as near as possible to the object they had in view, without diminishing its size. The consequence is that many of thir obelisks, pedestals, and sarcophagi, where one would have supposed the most scrupulous attention to uniformity would have existed, are irregular in shape. The sides of an obelisk rarely corresponded exactly with the breadth of its face, or the height of the shaft to any fixed relation with the width at the base; and there is a like disregard in the height of the pyramidion (the pyramid-like apex), which, however, was high-peaked and never stunted. Nevertheless we may assume that the shaft varied from eight to nine diameters high up to the pyramidion, which itself was from sixty to seventy-five hundredths of the breadth at the base. The four sides or faces of the obelisk were usually square, but occasionally they were convex; a fact proving the nice perception for effect which prevailed in the minds of the Egyptians, as thus the light was much softer upon the surface, the shades less crude, and the angles less cutting. Some of the huge blocks intended for obelisks came from the quarry misshapen at the smaller end, and to remedy such a defect they covered it with a metal capping of the required shape rather than reduce its length by cutting off the rugged portion. The summit of the Luxor obelisk, now in Paris, was irregular in shape and quite rough, and must originally have been capped with metal. Usually, obelisks had one, two, or three vertical hieroglyphs. It may be assumed that only one series was intended by the original Pharaoh; but it appears that his son, successor, or successors, added a line on each side; and it is remarkable that earlier hieroglyphs were much deeper cut than the more recent ones. Mariette Bey, the Egyptologist, mentions the fact that the faces of obelisks were sometimes gilded, the hieroglyphs themselves retaining their original color and actual surface of the granite. On the subject of the dies, pedestals, and steps upon which the monoliths were anciently raised we have little information, for the bottom portions of those now left standing are encumbered and surrounded by huge fallen blocks of stone, preventing their full size from being seen.

All of the large monoliths were of pink granite taken from the quarries of Syene. The position of these quarries must have been of the utmost importance in facilitating the application of that fine material. Situated below the cataracts, when once the masses were extracted from their beds, no obstruction presented itself in their course down the river to their destination, whether to Memphis, Heliopolis, or the delta. Twenty-seven of the forty-two obelisks now known were from Syene, and they are doubtless the largest. An unextracted block still remains at Syene, 95 feet long by 11 feet in diameter, with the quarrymen's marks on it. Sir Gardner Wilkinson states that the final operation of extraction, when three sides of a mass had been worked around, was by cutting a groove or channel about a couple of inches in depth, and kindling a fire along its whole extent. When the stone was intensely heated, cold water was poured into the groove, and the block detached itself with a clear fracture. Wedges of wood were also inserted, saturated with water, then exposed to heat, and the expansion rent the mass asunder. Thus detached it was drawn down to the river, where it was incased, or upon a galley or raft floated down the Nile to near the spot where it was ultimately to be set up. From the river bank it was then hauled up to the Propylea in front of which it was to stand. There are no hieroglyphics or paintings extant to show us how the obelisk was raised and placed in its final position. That this was a most critical operation is obvious, and its difficulty is illustrated by an anecdote related by Pliny: Rameses erected one obelisk 140 cubits high and of prodigious thickness. It is said 12,000 men were employed on the work. To insure the safety of the operation by the extremest skill of the architect, he had his own son fastened to the summit while it was raised.

As to the tools used in carving the granite we know nothing. Hardly any iron tools have been preserved among the relics of the tombs. With what material did the Egyptians sculpture with such refined delicacy and exquisite sharpness the mouth, eyes, ears, and other features of their statues, and the sharp contours of their hieroglyphs? We are possessed of no process by which brass may be sufficiently hardened for the purpose. Could they have softened the surface by some chemical operation on the harder elements of the stones? No one has as yet been able to inform us, and the secret mystery of the execution of the Egyptian sculpture still excites our wonder and admiration.

The positions of obelisks were before the gigantic pylons which formed the entrance gateways to the fore courts of their temples, and they were without exception always in pairs. At Karnac the situation of the two lofty ones erected by Queen Hatsou (one of which still stands, and is 108 feet 6 inches high, the tallest known) was between two lofty pylons only forty to fifty feet apart. Those in front of the outer pylon are not so distant in advance of it. Consequently the Egyptians disregarded the immediate proximity of a high wall backing them up, and none are known situated in wide open spaces. The sacred way led up from the river, flanked on each side with variously headed sphinxes. At Karnac the dromos is one mile and one-third long, with a line of sphinxes on each side. Approaching nearer, the worshipper finds two obelisks on the right and left, not necessarily of the same height. At Luxor one is seven or eight feet higher than the other, and to diminish the disparity in size, the shorter one is raised on a lofty pedestal and brought some feet in advance of its companion. Attached to the face of the pylon are six gigantic sitting statues of kings, majestic in size, and seated in the hieratic posture. The pylon itself, perhaps 200 feet wide and 100 feet high, forms the background of the whole, crowned by its cavetto cornice, and its surface covered with the colored sculptures of the victorious Rameses in his chariot, with upraised arm, slaying his enemies, trampling them under his horses' hoofs, and alone dispersing them in flight. In the center of the structure is the portal, 56 feet high, through which the sacred or triumphal procession pas se all its gorgeousness to within the sacred precincts, there to observe the ritual ceremonies of the mysterious Egyptian cult of one or more of their eight great divinities or animal gods. Erasmus Wilson, in his book entitled "Cleopatra's Needle" (p. 178), enumerates the existing obelisks as follows: Rome, 12; Italy, in addition, 4; Egypt, 6; Constantinople, 2; France, 2; England, 6; Germany, 1.

For nearly 2,000 years there have stood on the shores of the Levant, near Alexandria, two obelisks of rose-colored granite known as "Cleopatra's Nee dles." We are told by Egyptologists that they were taken from the quarries at

Syene, and thence conveyed to Heliopolis, where by Sesostris they were set up before the entrance to the temple of the god Tum, or the Setting Sun. Pliny states that they were transported to the Nile with the aid of flat-bottomed boats, floating in canals specially prepared for that purpose. Sharpe says that they were placed in an erect position by cutting a groove in the pedestal, in which the lower edge of the monolith might turn as if it were a hinge, the top of the shaft being elevated by means of a mound of earth, the size of which was continually increased till the stone stood securely erect. The obelisks were brought to Alexandria during the reign of Tiberius, but bear their present popular name because of a tradition that they were taken to Alexandria in the time of Cleopatra. Their age is estimated to be about 3,300 years. One of the obelisks has until recently been standing where it was originally placed when brought to Alexandria, but the other, which is the less perfect of the two, has for many years been lying prostrate on the sand. In 1819, Mehemet Ali offered the fallen monolith to the Prince Regent of England, and the British Government accepted the gift, but afterward declined to act in the matter because of the expense attending removal. In 1851, the subject was again brought up; but, as before, no action was taken. Finally, in 1876, Dr. Erasmus Wilson concluded to pay the expenses himself of transporting the great monolith, and bargained with Mr. John Dixon, a well-known engineer and contractor, to bring it to England and erect it on the Thames Embankment for $50.000. Both of these "Needles"—the one transported to England, and its more perfect companion recently presented to the United States by the Khedive of Egypt—possess great historical value, aside from that sentimental estimation which enlightened nations place upon all monuments of antiquity. As far as known the hieroglyphs on the obelisk which is coming to this country have never been deciphered, but as both obelisks are of the same age, and came originally from the same city and temple, it is not unlikely that the inscriptions refer to the same, or, at least, to similar subjects. When the London obelisk was unearthed, it was found to be just 68 feet long, and its weight about two hundred tons. The hieroglyphics which covered each of its four faces were washed, and then deciphered by Brugsch Bey, the eminent Egyptologist. He found that they referred to the lives of the two Kings, Thothmes III. and Rameses II. Subsequently a correct translation of the whole has been made by Dr. Samuel Birch, of the British museum, and is as follows:

"First Side, Central Line, toward east when erected on Embankment.—The Horus, lord of the upper and lower country, the powerful bull; crowned in Uas or Thebes, the King of the North and South Ramen Cheper has made his monument to his father, Haremachu (Horus in the horizons), he has set up to him two great obelisks, capped with gold, at the first time of the festivals of thirty years, according to his wish he did it the son of the Sun Thothmes (III.) type of types did it beloved of Haremachu (Horus of the horizons) ever living.

"First Side—Left Line.—The Horus of the upper and lower country, the powerful bull, beloved of the Sun, the King of Upper and Lower Egypt, Ra-user-ma, approved of the Sun, lord of the festivals, like Ptah-Tanen, son of the Sun, Rameses beloved of Amen, a strong bull, like the son of Nu (Osiris), whom none can withstand, the lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"First Side—Right Line.—The Horus of the upper and lower country, the powerful bull, son of Tum, King of the South and North, lord of diadems, guardian of Egypt, chastiser of foreign countries, son of the Sun Ramessu (II.), beloved of Amen, dragging the South to the Mediterranean Sea, the North to the Poles of Heaven, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun Ramessu (II.), giver of life, like the Sun.

"Second Side—Central Line, toward river (south), as erected on Embankment.—The Horus of the upper and lower country, the powerful bull, crowned by Truth, the King of the North and South, Cheper. The lord of the gods has multiplied to him festivals on the great Persea tree in the midst of the place of the Phœnix (Heliopolis). He is recognized as his son, a divine chief, his limbs come forth daily as he wishes, the son of the Sun Thothmes (III.), ruler of An (Heliopolis), beloved of Haremachu (Horus in horizons).

"Second Side—Left Line.—The Horus of the Upper and Lower country, the powerful bull, beloved of Truth, King of the North and South Ra-user-ma, approved of the Sun, born of the gods, holding the two lands (of Egypt), as the son of the Sun, Ramessu (II.), beloved of Amen, making his frontier wherever he wished, who is at rest through his power, the lord of the two countries, Ra-user-ma, approved of the Sun, Ramessu beloved of Amen, the luster of the Sun.

"Second Side—Right Line.—The Horus of the upper and lower country, the powerful bull, son of the god Chepera, the King of the North and South, Ra-user-ma, approved of the Sun. The golden trait, rich in years, the most powerful, the eyes of mankind behold what he has done, nothing has been said in opposition to the lord of the two countries. Ra-user-ma approved of the Sun, the son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"Third Side—Central Line, west side as erected on Embankment.—The Horus, lord of the upper and lower country, the powerful bull, beloved of Truth, the King of the South and North Ramen Cheper, his father Tum has set up to him his great name, placing it in the temple belonging to An (Heliopolis), giving him the throne of Seb, the dignity of Cheper, the son of the Sun, Thothmes (III.), good and true, beloved of the Spirits of An (Heliopolis), ever living.

"Third Side—Right Line.—The Horus of the upper and lower country, the powerful bull, well beloved of Ra, the King of the South and North Ra-urser-ma, approved of the Sun, lord of festivals of thirty years, like his father Ptah, son of the Sun, Ramessu (II.), beloved of men, son of Tum, beloved of his loins; Athor, the goddess, directing the two countries, has given him birth, the lord of the two countries, Ra-user-ma, approved of the Sun, the son of the Sun, Ramessu, (II.), beloved of men, giver of life, like the Sun.

"Third Side—Left Line.—The Horus, lord of the two countries, the powerful bull, son of the Shu, the King of the South and North, Ra-user-ma, approved of the Ra, the lord of diadems, director of Egypt, chastiser of foreign lands, son of the Sun, Ramessu (II.), beloved of Amen, bringing his offering daily in the house of his father Tum, not has been done as he did in the house of his father, the lord of the two countries, Ra-user-ma, approved of the Sun, the son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"Fourth Side—Central Line, toward Road (north), as erected on Embankment.—The Horus of the upper and lower country, beloved of the god of the tall, upper crown, the King of the South and North, Ramen Cheper, making offerings, beloved of the gods, supplying the altar of the Spirits of An (Heliopolis), welcoming their persons at the two times of the year, that he might repose through them with a sound life of hundreds of thousands of years with very numerous festivals of thirty years, the son of the Sun Thothmes (III.), the divine ruler, beloved of Haremachu (Horus of the horizons), ever living.

"Fourth Side—Right Side.—The Horus, lord of the upper and lower country, the powerful bull, beloved of Ra, the King of the South and North, Ra-user-ma, approved of the Sun, the Sun born of the gods, holding the countries, the son of the Sun Ramessu (II.), beloved of Amen, the strong hand, the powerful victor, bull of rulers, king of kings, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, beloved of Tum, lord of An (Heliopolis), giver of life.

"Fourth Side—Left Line.—The Horns, the powerful bull, son of Ptah-Tanen, lord of the upper and lower country, the King of the South and North, Ra-user-ma, approved of the Sun, the hawk of gold, rich in years, the greatest of victors, the son of the Sun Ramessu (II.), beloved of Amen, leading captive the Rutennu (Syrians) and Petit (Libyans) out of their countries to the seat of the house of his father, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, beloved of Shu, the great god, like the Sun.

"The scenes on the pyramidion represent the monarch Thothmes III., under the form of a sphinx, with hands offering to the Gods Ra and Atum, the two principal deities of Heliopolis. The offerings are water, wine, milk, and incense. The inscriptions are the names and titles of the deities, the title of Thothmes III., and the announcement of each of his special gifts.

As before stated, the obelisk which is coming to this country is the more perfect of the two, and is the one usually referred to in the books as *the* "Cleopatra's Needle." The fact that the Khedive should have presented this noble monument to America has excited considerable ill-natured comment in England, and has been regarded with considerable jealousy. The temple at Heliopolis, where these two monoliths originally stood, is of interest to biblical students, as it is supposed to be one in which Moses became learned in all the wisdom of Egypt. When the inscription on our "Needle" shall have been deciphered, further light may be shed upon the history of the remote past in Egypt, which is so profoundly connected with the whole rise and progress of the religions, the philosophies, and the arts of our own race and our own times.

The method of lowering and transporting the obelisk to this country is entirely original with Lieutenant Commander Gorringe, who has been intrusted with the entire matter. The gigantic framework to be used in lowering the monolith was shipped for Liverpool, October 7th, 1879, on board the Guion steamer Nevada.

From Liverpool it was transhipped to Alexandria, where it arrived safely, and the work of erection immediately began. The machinery was constructed at the works of Messrs. Roebling's Sons Company, at Trenton, after plans made by Lieutenant Commander Gorringe, its total weight being 128,000 pounds. The first operation after arriving at Alexandria was, after erecting the proper scaffolding, to incase the monolith with 2-inch oak planking, bound at intervals of 3 feet with strong iron bands. Then the obelisk was guyed at the top from four points, like the mast of a vessel, so that there could be no possibility of its falling over. The center of gravity had been calculated at a point of twenty-six feet above the base, and here trunnions were placed on either side and bolted across the sides by eight 1¾-inch iron and four 2-inch steel bolts. The trunnions were cast from cannon metal only, and that of the best quality. The trunnion plates were four inches thick, nine feet wide, and six feet high. At the center was the turned trunnion, 33 inches long, and 18 inches in diameter. The weight of each trunnion and plate was 1,250 pounds, making together 1¼ tons. The next operation was to quarry out four 6-inch channel ways through the base of the obelisk, and insert I beams to assist in raising the foundations. Next the foundations were constructed. These consisted of two platforms, one on each side, of 3-inch oak planking, each 6 feet wide and 24 feet long. On top of these were set four oak sticks, 12 by 18, firmly bolted together. The iron work of the towers was then built on top of the preliminary foundation. Each tower was constructed of six 12-inch heavy wrought iron I beams, spreading out at the base to a distance of 21 feet, and converging at the top to within 5 feet. The beams at their base rested on four heavy I beams, and were securely riveted to the platform by means of plates and knees. Placed on top of these posts were caps, each five feet long and thirty inches wide, which also were secured by means of plates and knees. The posts were braced from top to bottom by angle and channnel irons, making the towers perfectly rigid. Placed on top of the caps, and securely bolted to the tower proper, were cast iron journals weighing 3,700 pounds, each forming the grooves for the trunnions to work in. A 6-inch rib had been cast in the bottom of each of the trunnions, and in these ribs were four 2-inch holes. Through each of these holes 1¾-inch iron rods were inserted, connected with similar from the 6-inch I beams running through the base, by means of right and left thread turn buckles, which were used to raise the obelisk from its foundation and throw the weight on the trunnions. On the 6th of December, everything being ready, the monolith was successfully raised in the presence of

5,000 people who had come to witness the operation; the foundation was then removed, and the obelisk left hanging free. The obelisk having been turned over to a horizontal position, Captain Gorringe next proceeded to build two piles of beams placed crosswise; and, as soon as they reached the height of the stone, jacks were used to lift the latter out of its trunnion bearings and block it up. All the construction was then removed, and, foot by foot, the obelisk was lowered to the ground by reducing the piles, first from one side and then the other. On the ground the obelisk was incased in an iron cradle, consisting of a parabolic truss on each side, connected by means of heavy channel flow beams and braces. To the flow beams two heavy channel bars were riveted, and corresponding channels were laid on the ground to form the track for the obelisk to move on, the movement being effected by inserting 8-inch cannon balls into the grooves formed by the channel bars, and the track being laid sixty feet ahead of the cradles, so that as the stone was pushed along, the track behind was taken up and placed in front. From the base of the obelisk to the sea a trench had been dug, which, at the end near the sea, is 95 feet long by 40 feet broad, and 16 feet deep; in this portion a float, constructed for the purpose, will be used to transport the obelisk to the port of Alexandria, a distance of about a mile in a straight line. In digging the pit around the base of the monolith, Captain Gorringe discovered that the shaft stood on a pedestal, the existence of which was before unknown. It was 9 feet square, 7 feet in height, and rested upon three well-preserved marble steps with a base of masonry. From the lower surface of the lower step the obelisk rises 81 feet 2½ inches to its summit, and its estimated weight is about 196 tons. At the port of Alexandria the obelisk will be placed on a large ship selected for the purpose, and so brought to this country. [This plan is very different from that adopted by the English engineer, which, it will be remembered, was to inclose the obelisk in a cylindrical vessel formed of wrought iron plates, and provided with water-tight compartments. This, after being rolled into the sea, and towed to the harbor, was ballasted and provided with a keel, deck, sail, and rudder. The vessel was then placed in charge of two or three skilled mariners, for whom a small cabin on deck was provided, and towed to England by a steam tug, the sail being simply for steadying the cylinder.] Should our obelisk reach port in safety the same machinery, with very slight modification, will be used to place it in an erect position, after a proper site has been selected for it.

There can be no doubt that our citizens, as they pass by this obelisk after its erection, will have their curiosity excited by the sight of hieroglyphs which have probably been seen and read by the Jews at the time of Moses, or when the Savior was taken by his parents to Egypt as a place of refuge from Herod's rage.

The following is a list of the more notable obelisks, with their present sites, sizes, etc.:

OBELISKS.

Present Site.	Size.	Height.	By or to whom Dedicated.
	ft. in. ft. in.	ft. in ft. in.	
Heliopolis	6 1 × 6 3	68 2 or 66 6	Osortisen, 2,851 B. C.
Biggeg-Crocodopolis	6 9 × 4 0	43 ft. 0 in.	Ditto.
Karnak	. . . . . .	90 6	Thothmes I.
Ditto	Mariette.	108 10	Hatasou, 1,660 B. C.
Lateran, Rome	9 8 × 9 10	105 6	Thothmes III.
Vatican, Rome	8 10	82 9	No hieroglyphs.
Alexandria *	7 7 × 8 2	70 0	Thothmes III.
London	7 10¼ × 7 8	68 5½	Ditto.
Constantinople	Broken.	50 0	Ditto.
Sion House	0 10⅞	7 6	Ditto.
Thebaid, Alnwick	0 9¾ × 0 9	7 3	Amenotep II.
Porta del Popolo, Rome	8 5 × 8 5	78 6	Seti Menepthah I.
Trinità del Monti, Rome	4 3	43 6	Ditto.
Luxor	. . . . . .	82 0	Rameses II.
Paris	8 0 × 8 0	76 4	Ditto.
San, or Tanis	. . . . . .	. . . . . .	Ditto.
Monte-Citorio, Rome	. . . . . .	71 5	Sesostris.
Piazza Navona, Rome	4 5	54 3	
Pantheon, Rome	Fragment.	50 0	Ditto.
Villa Mattei, Rome	8 3		
Piazza Minerva, Rome	Fragment.	17 0	
British Museum, 2	1 6 × 1 5	8 2	Amyrtæus I.
Constantinople	6 0 × 6 0	35 0	Nectancho I.
Corfe Castle, Philæ	2 2	22 1½	Ptolemy Evergetes II., 150 B.C.
Benevento	. . . . . .	9 0	
Monte Pincio, Rome	. . . .	30 0	Hadrianus.

*Presented to the United States.

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GEOLOGY.

THE PRESENT STATE OF THE EVIDENCE REGARDING THE ANTIQUITY OF MAN.*

BY T. MCK. HUGHES, M. A., WOODWARDIAN PROFESSOR OF GEOLOGY, CAMBRIDGE.

[The following paragraphs, discussing the evidence as to Man's existence in or before the Glacial era in Europe, and the remarks succeeding, by Professor Dawkins, are cited from a paper bearing the above title.]

We may dismiss at once the case [of supposed human remains], reported

*Read before the Victoria Institute, 1879.

from the Dardanelles, of works of art found in deposits said to be of Miocene age. The descriptions* prove that it was not given on the authority of one competent to judge in such a case, and it never has been confirmed.

In beds said to be Miocene, at Thenay, near Pontleroy, the Abbè Bourgeois found flints which he supposed were dressed by man. These flints are now exhibited in the Museum at St. Germain, where I saw them with Sir Charles Lyell several years ago, and again with others since. Some of them seemed entirely natural, common forms, such as we find over the surface everywhere, broken by all the various accidents of heat and frost and blows. A few seemed as if they might have been man's handiwork—cores from which he had struck off flakes such as we know were used by early man, of which I show examples. Yet this is not quite clear, for, had the evidence been good that they were found in place, there still would have been a doubt whether they were man's work. But when we came to inquire about the evidence that they occurred in beds of Miocene age, we learned that only those that we put down as natural were found by the Abbè himself; the others were brought in by workmen, picked up, we may suppose, upon the heaps turned over by their spades, and so perhaps, just dropped down from the surface.

Next in the Crag the teeth of sharks, bored through, as if for wear, were found,† part of a string of ornaments such as are commonly worn by savages. Of these I give examples: one a boar's tusk, from the lake dwellings of Switzerland; another, a tooth from a deposit of palæolithic age, in a cave just above the miraculous grotto of Lourdes in the Pyrenees. I have examined fragments of bone and teeth [from the Crag] of various sizes and shapes, and found them marked over the surface with many a pit or deeper hole, or even perforation irregularly placed, not as if by design, but by accident. There they were in every stage, all over, yet of one type. One sawn across explains the whole. The chamber of a shell which bores its way into the solid rock or softer shale was clearly shown. When the mass lay embedded in the mud it was but touched here and there. If it was thin the animal bored through into the sand or clay below, piercing the tooth quite through—a perfectly well-turned and finished work, so good it was thought to be man's. But if the mass was thick and near the surface, the little mollusk made a home entirely within it, and its shell often remains there, and reveals the history and manner of formation of the holes.

An account has also been given by the Abbè Bourgeois of flints from Pliocene beds at St. Prest, near to Chartres, said to be worked by man, but this we may dismiss on the same ground as those before referred to given on the same authority.‡

Another case brought forward from abroad but recently, has found as much favor here as there.§ Around the Lake of Zurich there are left traces of ancient lakes at somewhat higher levels. A bed of clay below with glacial stones, a bed

*Journ. Anthrop Inst., vol. iii, p. 127, April, 1873.

†Journ. Anthrop. Inst., vol. ii, p. 91 April, 1872.

‡Bourgeois, Congr. Inter. d'Anthrop., 1867, p. 67.

§Rutimeyer, Archiv. fur Anthropologie, 1875; Heer, Primæval World of Switzerland.

of plants between, half-turned to coal, a mass of clay, moraine-like on the top, tell of the time when Alpine ice crept farther down the hills, and touched upon the lake, now more, now less encroaching. In these beds the peaty mass of lignite, known as Dürnten coal, was largely dug for fuel. I have worked a long time down below to see the evidence myself. The sequence of the beds is clear. But recently two Swiss professors have proclaimed that they have obtained proofs incontestable that man was there, and wove a basket, fragments of which were found among the drifted plants which formed the coal. These fragments, it is said, consist of pointed sticks, sharpened across the grain, not tapering naturally, and a cross set of binding withes, all now pressed and changed, but by such characters referred to work of man. Now I have found myself along the shore fragments of wood and twigs half decomposed and waveworn till they were cut to a point obliquely to the grain, as they describe the Dürnten sticks. Across such fragments often others fell, and when the whole was then compressed what wonder if they left a mark of wattle or of basket-work? and the whole mass has suffered such great pressure from the superincumbent weight of clay that all the round twigs and stems are squeezed quite flat, as in the specimens before you. These Dürnten pointed sticks, however, I have not seen, and, therefore, speak with caution, showing only how I think the thing might be otherwise explained.

Widespread beds of loam and sand, and gravel, cover the lower levels of East Anglia; and, probably ranging over a vast period, have been collectively described as "middle-glacial," for below are glacial beds, and in the middle series bowlder clay, and over them, whether in part *remanie* or not, another bowlder clay. Lying in hollows and on the flanks of valleys, cut through this ancient loam and other beds, are river terraces of later date; and these, because in great part made up of the older beds, are like them, and require experience to distinguish. In these old terrace-deposits implements of man's undoubted work have long been found; but recently it has been said that some of these beds belong to the older series.‡ This, then, becomes a matter of opinion. For my part, being well acquainted with the deposits in question, and having listened to the evidence, I give my testimony quite against the Glacial or inter-Glacial age of any of the beds from which the hatchets came. It is, however, said that other evidence has since been found, conclusive as to this. I can but criticise that which has been adduced; but I will say that if such has been found and been so long withheld, while there are so many deeply interested, and so many who would like to verify at once and on the ground, the statements made, then I do hold that there has not been shown that love of full investigation which is the soul of science.

In many countries where rocks of limestone tower in cliffs and crags above the valleys, and are tapped below by undermining streams, the rain which falls upon the higher ground is lost in cracks and joints, and carries off the rock dissolved in water, which contains a little acid caught by the falling rain or drawn from decomposing plants. The fissures thus enlarged into the gaping chasms called "swallows' holes," the "katabothra" of the Greeks, admit a copious tor-

‡Mem. Geol. Surv. Geology of Fenland.

rent, carrying stones and sand which grind and bruise and open out the jointed rocks into great caves and subterranean courses. These, when tapped at lower levels, are soon left dry, and offer to prowling beasts of prey a safe retreat, and often man availed himself of them, as testify the Adullamites and Troglodytes of every age.

From such a cave up in the crags of Craven some evidence is adduced tha man existed far back into Glacial times, and this, perhaps, is the best case that has been urged* There a large group of animals, such as occur elsewhere along with man, and more doubtfully, traces of man himself, were found in beds over lapped by Glacial clay which had sealed up the mouth of the vast den in which these relics lay. This excavation I have watched myself at intervals from the commencement, and I hold that as the cliff fell back by wet or frost, and limestone fragments fell over the cave mouth, with them also came masses of clay, which, since the Glacial times, had lain in hollows in the rock above. We dug and found such there, and, more, I observed that the clay lay across the mouth as though it had thus fallen, and not as if it came direct from Glacial ice that pushed its way athwart the crag in which the cave occurs. It seemed to have fallen obliquely from the side where the fissured rock more readily yielded to the atmospheric waste, so that it somewhat underlay the part immediately above the cave. On the inside the muddy water which collected after flood, held back by all this clay, filled every crevice and the intervals between the fallen limestone rock, while still outside was the open *talus* of angular fragments known as "screes."

These are the most important cases that I know where man has been referred to Glacial or inter-Glacial times; but, all, it seems to me, quite inconclusive. On the contrary, there is much in them, and much besides, pointing the other way. In support of which opinion I will now offer some independent evidence, showing that some similar beds with man and the beasts that are found with him in earliest times can be proved to be post-Glacial. * * *

[*Remarks on the foregoing paper by Professor W. Boyd Dawkins, F.R.S.*]

I entirely hold with Professor Hughes in the view which he takes relating to the antiquity of man, and the necessity of looking narrowly into facts bearing on the question. All the alleged cases of the existence of man before the Palæolithic age, on the Continent, seem to me on a careful inquiry to be unsatisfactory. If the flints found at Thenay, and supposed to prove the existence of Miocene man, be artificial, and be derived from a Miocene stratum, there is, to my mind, an insuperable difficulty in holding them to be the handiwork of man. Seeing that no existing species of quadruped was then alive, it is to me perfectly incredible that man, the most highly specialized of all, should have been living at that time. The flints shown in Paris by Professor Gaudry appear to be artificial; while those in the Museum of St. Germain appear to be partly artificial and partly natural, some of the former, from their condition, having been obviously picked up on the surface of the ground. The cuts on the Miocene fossil bones

*Tiddeman, Brit. Assoc. Reports, 1870-8.

discovered in several other localities in France may have been produ ed by other agencies than the hand of man.

Nor in the succeeding Pliocene age is the evidence more convincing. The human skull found in a railway cutting at Olmo, in Northern Italy, and supposed to be of Pliocene age, was associated with an implement, according to Dr. John Evans, of Neolithic age. Some of the cut fossil bones discovered in various parts of Lombardy, and considered by Professor Capellini to be Pliocene, were undoubtedly produced by a cutting implement before they became mineralized, a point on which the examination of the specimens leaves me no reason for doubt. I do not, however, feel satisfied that the bones became mineralized in the Pliocene age; and the fact, that only two species of quadrupeds now alive then dwelt in Europe, renders it highly improbable that man was living at this time. This zoölogical difficulty seems to me insuperable.

The only other case which demands notice is that which is taken to establish the fact that man was living in the inter-Glacial age, in Switzerland. The specimens supposed to offer ground for this hypothesis consist of a few pointed sticks in Professor Rütimeyer's collection at Basle, of the shape and size of a rather thin cigar, crossed by a series of fibers running at right angles. They appear to me after a careful examination to present no mark of the hand of man, and to be merely the resinous knots which have dropped out of a rotten pine trunk, and survived the destruction of the rest of the tree. As the evidence stands at present, there is no proof, on the Continent or in this country, of man having lived in this part of the world before the middle stage of the Pleistocene age, when most of the existing mammalia were alive, and when mammoths, rhinoceroses, bisons, horses and Irish elks, lions, hyenas, and bears haunted the neighborhood of London, and were swept down by the floods of the Thames as far as Erith and Crayford. —*American Journal of Science.*

PSYCHOLOGY.

AUTOMATIC MENTAL ACTION.

BY PROF. J. M. LONG.

The development of the life of man depends upon the dynamic arrangements in his constitution for action. Those who study man from both the physiological and the psychological point of view, should, therefore, take into the account all those springs of action with which the Creator has endowed him. That part of the physical nature of man directly concerned in action is the nervous system, the functions of which are the generation, transmission and distribution of motion. That part of the nervous organism known as the Cerebro-Spinal system may be properly termed the Physical Mechanism of Mind, because psychical phenomena are conditioned by its action. Psychical, or mental action, assumes three distinct forms, namely, Reflex, Latent, and Conscious.

We have two kinds of reflex mental action—one natural and instinctive; the other artificial and acquired. Reflex mental action is that form of psychical phenomena which occur without the intervention of consciousness, and which, though unconscious, accomplish ends analogous to those which take place under the direction of thought and volition.

We have what is termed a reflex psychical action when impulse is sent along an afferent nerve from the surface of the body, and which, on reaching the sensory ganglia, is reflected or thrown back along an efferent nerve, in the form of muscular motion. In this case an ingoing movement, resulting in a sensation, is converted into an outgoing movement without an intervention of consciousness. Such movements are called Automatic, because they are effected through the medium of the nervous mechanism mechanically, like the movements of automata. Illustrations of this class of psychic actions are furnished in the batting of the eyes when some object is suddenly thrust before them; in the unconscious throwing out of the hands to stay the body when about to fall; in the drawing up of the feet of a sleeping person when the soles are tickled.

To ascertain the seat of reflex psychical action, has been one of the interesting and important questions of modern psychology. The study of psychical phenomena from the objective point of view has proved that the brain is not the sole seat of mind. The seat of consciousness is in the brain; but the other forms of mental action cannot be restricted to that organ, but are developed, with more or less intensity, in the other parts of the nervous system. Consciousness is the eye of the soul, and is, therefore, a faculty. But it does not thence follow that the mind is active only when this faculty is active. The mind has other sources and springs of action. Descartes, followed by many philosophers, identified consciousness with mind, as though one should confound seeing with perceiving. Unconscious mental action we regard as the basis and condition of conscious mental action. In pure reflex actions, the brain, or cerebrum, takes no part. They are effected through the medium of the spinal cord and the other motor centers, of which the cord is a prolongation into the base of the brain. Hence, animals of a low order, being more tenacious of life than those highly developed, when deprived of their brains will still perform reflex movements. Brainless pigeons will smooth down their feathers; brainless frogs will rub off sulphuric acid which has been dropped upon them, or adjust themselves on a board as it is inclined at different angles. Infants, born without brains, have been known to perform the usual operation of sucking. There is said to be a man in a French hospital who, in consequence of a wound received in the late war with Germany, passes out from his normal conscious life once in each month, and lives, for a day or two, a life of unconscious reflex action, like a decapitated frog or pigeon. He neither sees, hears nor tastes, nor smells, having only one sense organ in a state of activity, namely, that of touch, which is exalted into a state of preternatural acuteness. Yet, without consciousness, he is said to go through his daily routine of movements with automatic regularity. All those accustomed actions he performs through the medium of the spinal cord and the other motor centers, independently of the brain.

Primary reflex mental action constitutes the innate and fundamental provision in the human organism for the maintenance of life. The conditions of life require that there shall be something from which to start at the time that the animal sets up an independent existence, in order that the organism shall be, to a certain extent, in harmony with environing relations. This primitive and innate provision for action is called Instinctive, because it is original and unacquired, and exists in its full power previous to experience and instruction. . Man, at birth, begins a life without knowledge and experience. In this condition, his only guide is instinctive reflex action, until intelligence and volition become developed. Hence, instinctive reflex action forms the basis upon which all subsequent mental development and education take plaee.

The organism of man is arranged in harmony with a fixed and preëstablished system of nature. To render the development of the organic and mental life possible, the rudimentary psychical nature must begin in unconsciousness, or reflex action, in harmony with the conditions imposed by external relations. As intelligence and will become developed, the mind rises into a consciousness of this preëstablished harmony which from the beginning has rendered the development of life, both mental and organic, possible. Thus the mind grows and develops from simple reflex action—which presents psychical phenomena in their lowest typical form—into conscious volition, in which the intelligence adjusts itself to the complex relations of space and time. We thus recognize simple reflex action as the germ out of which will is developed. Hence, to understand the nature of will, we must study it in its genesis as related to reflex action. It is also by studying primary reflex action that we become prepared to understand the nature of secondary reflex, or automatic action.

Secondary automatic mental action is one of the important contributions of modern psychology to mental science. Even after this doctrine had been stated and received as the only theory which could explain a certain class of mental phenomena, it was stoutly opposed by the metaphysical school of thinkers. Secondary automatic mental action belongs to that class of psychical activities which have, by the force of habit, assumed the form of aptitudes, and which go on without an effort of the will. Actions which, at first, require all one's attention, may, after many repetitions, become automatic, and go on, of their own accord, through the operation of the lower nerve centers, without a conscious effort of mind. The larger part of our daily mental actions which constitute the efficient machinery of life, is of this character, such as walking and reading aloud while the mind follows the thoughts of the author. If all the actions and mental processes which the necessities of our daily life impose upon us had to be brought under the review of consciousness, it would be burdened down with the weight of complex details.

The use and value of consciousness as a mental element in running the machinery of mind do not lie in what it is in itself, but in what its separate and successive states may become. By continual repetition, these separate states may become organized into a consolidated whole, which, like the individual cells in the animal organism, finally develops into a complex form of automatic mental action. Hence, the mental machinery does not consist in separate conscious states, but in organized forms of action into which the mind has grown by the force of repetition.

The fact of mental automatism finds its explanation on the physical side of being in the relation which the cerebrum sustains to the lower sensory and motor centers. Impressions are made on the cerebrum by being propagated upward through the sensorium. These impressions, after being combined and co-ordinated, are reflected downward to the motor centers which execute the mandates of the will in the form of muscular movements. By constant repetition, these motor centers grow into the modes of action which have been consciously and artificially imposed upon them, so that the only conscious effort required to set them going is a mere initiative impulse of the will. In this way the mental and the physical organism may be made to take on themselves an artificial and secondary automatic action, as distinguished from that which is natural and primary.

We should not pass over this part of the subject without calling attention to the important office which this form of action performs in the economy of human life. We should regard the spinal cord, together with the motor and sensory ganglia, in which it terminates, as charged with spontaneous force, and as consequently the seat from which emanate "the lightning gleams of power" exerted for the well being of the organism. Man must have some provision in his constitution which shall serve as a guide and protection, before he can rise into the dignity of an intelligent and conscious being. Such are the dangers to which life is often exposed, that action must come before thought to save the organism, or some part of it, from destruction.

Automatic mental action has a most important bearing on education, whether this looks to physical, intellectual, or moral and religious training. It is that, in fact, which makes man an educable being. It is only the new school of psychologists who, as yet, fully recognize the great value of this form of action as one of the capacities of our physical and mental being. "It is," says Huxley, "because the body is a machine that education is possible. Education is the formation of habits, a superinducing of an artificial organization upon the natural organization of the body; so that acts, which at first required a conscious effort, eventually become unconscious and mechanical. If the act which primarily requires a distinct consciousness and volition of its details, always needed the same effort, education would be an impossibility." "The acquired functions of the spinal cord," says Dr. Maudsley, "and of the sensory ganglia, obviously imply the existence of memory, which is indispensable to their formation and exercise. How else could these centers be educated? The impressions made upon them, and the answering movements, both leave their traces behind them, which are capable of being revived on the occasion of similar impressions. A ganglionic center, whether of mind, sensation, or movement, which was without memory, would be an idiotic center, incapable of being taught its functions."

The educators of youth should never lose sight of the fact that their work is well done only when both mind and body have been trained to act with automatic readiness and precision. This high degree of mental and physical power and specialization can be attained only by incessant repetition. Practice, and practice alone, makes perfect.

All beginnings are difficult; but, by virtue of this capacity for automatic mental action, they become easy and pleasant, so as to require little or no effort of the will to spur the mind on to its accustomed work. After this form of mental action has once been acquired, the mind is no longer perplexed with the routine of petty details, but is left free to attend to the few unaccustomed matters which turn up during its regular work, and which require a distinct consciousness.

The educator of youth, in availing himself of this spring of action, must take into the account the question of vital dynamics. Unless he does this, he is liable to err in two particulars: first, as to the extent to which this form of mental action should be carried; second, as to the class of mental operations to which it should be confined. Automatism requiring long and laborious repetition must make a heavy draft upon the plastic energies of the brain. The consumption of all the nervous energy in organizing automatic forms of action would result in a deadening of consciousness, and tend to reduce the mind to the level of a machine. Prof. Huxley says that he would not object to being thus reduced, provided that when wound up in the morning, like a clock, he would run on with automatic precision, and never go wrong. But such a result, if possible, would not be desirable, for the reason that it would put an end to all further mental progress in making new acquisitions. Mental operations by repetition tend to wear for themselves a channel. The nervous mechanism embodies in its structure the impressions made upon it as a part of its organic growth. But this mechanism of nerves is truly a machine, governed by mechanical laws, and is hence capable of performing only a limited amount of work. If a certain amount of the brain force be consumed in impressing upon the organism a particular form of action, just so much less will be left as a stimulus for exciting the mind to other acquisitions. Hence, if automatism has been carried to excess, the effect upon the young and growing organism must be injurious. The rigid and automatic condition of the nervous mechanism produced by habit, brings on a corresponding rigidity and deadness of consciousness itself, thus rendering the mind incapable of further progress. Automatic action gives efficiency and ease of execution; but, if carried too far, renders it difficult and even impossible to make new acquisitions.

It is also evident that automatic action should be confined to those mental and physical movements which will be of daily use, which look to the practical side of life, and which, from their nature, must be largely automatic to fulfill their ends. Learning to play on the piano, or other musical instrument, must attain to automatic quickness, to give that ease and readiness of execution which the nature of the process demands. The fundamental operations of arithmetic should be so thoroughly learned as to be largely automatic. When these fundamental processes of numbers have become organized, as it were, in the mental organism, the mind is then left free to attend to the logical processes involved in the mathematical operations. But, for the reason that automatism is an expensive acquisition, it should be limited to such mental operations as necessarily demand it. Those operations which can be well performed by deliberate thought, should be left to the conscious control of the will.

1. The education of the mental organism into automatic action should begin early, while the nervous system is plastic and impressible.

2. One of the practical problems of education is to duly antagonize consciousness and automatism.

3. The energies of childhood should not be utilized in the automatic demands of business, for this would bring on an arrested development of mind and body.

4. The mental life of the school demands that provision should be made for the exercise of both these forms of mental action, the automatic and the conscious.

PHYSICS.

A TALK ABOUT LIGHTNING.

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A year or two ago a house not far from Cincinnati was struck by lightning, and its inmates were pretty well scared. Among them was quite an intelligent young lady, recently from school, who had studied a little about electricity, and knew that metals would attract the spark. The flash had fallen, the danger was over, but her panic remained; and in her fright she rushed eagerly down stairs in search of a pair of scissors with which to cut the steel buckles from her shoes. This act, comical as it seems in all its bearings, was yet based upon rational grounds. To be sure it was like closing the stable door after the horse had been stolen; of course the young lady might simply have removed her shoes; and we all know, moreover, that lightning does not generally attack its victims' feet first, unless, indeed, they happen to be sitting in what might be termed the bar-room attitude. Yet the fact remains that the wearing of metals during a thunder storm slightly increases the danger of the wearer. The metallic object has a determining influence upon the course of the flash. In one instance a lady's bonnet, because of its wire framework, was entirely consumed by lightning, although the lady herself escaped serious injury. Another lady inadvertently thrust her arm out of a window during a thunder shower, and her gold bracelet was dissipated in vapor. Still another flash of lightning found a gentleman seated on the top of a stage coach and rifled his pocket of a valuable watch, leaving only a few links of the chain. The general fact which our heroine had in mind is, then, quite clear. Only her peculiar application of it serves very well to illustrate the crudity of popular notions about lightning. Many people are so bewildered and dazzled by the flash, and so stunned by the explosion which follows, that they become unable either to appreciate the beauty of the display, or to reason correctly concerning its nature. Indeed, very few persons realize how varied are the phenomena presented by the lightning in its color, its form, and its effects, and still fewer understand in more than a vague, general way, the principles involved in the erection of conductors. Every summer the country is scoured by lightning-rod agents, each with some eccentric contrivance to sell, who not only take advantage of the popular ignorance, but even make it deeper still. Spiral rods, patent tips, novel insulators, and goodness knows what else, are carried from house to house and forced upon the attention of puzzled listeners with an assiduity worthy of better employment. In consequence, a great many of the rods put up are not only unsuitable and inefficient, but also much more costly than thoroughly good, substantial and adequate conductors even need to be.

Lightning, by the best observers, has been divided into three kinds. First, there is the common zigzag line of light, sometimes as much as ten miles long, which seems to shoot from point to point with great velocity, and which lasts, it has been estimated, only about the thousandth part of a second. Secondly, there is what is known as "sheet lightning," in which vast masses of clouds are suddenly illuminated, as if from behind, no line being seen. This flash is also of inconceivably short duration, and varies much in color. White, blue, purple, violet, and rose-color are common tints for it to have. With it may be classed the so-called "heat lightning" of hot summer nights, which is probably but the reflection of active lightning at a distance. It is worth noting in this connection that thunder is rarely heard more than ten miles away, so that the flashes are often visible when no sound can be detected. The roar of artillery, as at Waterloo, has been audible at a distance of over eighty miles from the scene of battle. The third kind is called "globular lightning," and is comparatively rare. It appears like a ball of bluish fire, rolling with relative slowness on or near the surface of the ground or of the sea. When it reaches certain obstacles the ball explodes with a loud noise and works much mischief. When two young ladies were killed by lightning on the Malvern Hills, England, in June, 1826, the discharge was described as a globe of fire which rolled slowly along the ground toward the building in which they had taken shelter. Such a globe has been known to remain in sight for at least ten seconds. Another remarkable case of this kind of lightning is mentioned by Mr. Chalmers, who saw it from on board ship in 1749. His attention was called to a ball of blue fire, as big as a millstone, which was rolling along the surface of the water three miles away. Very soon it reached to within forty yards of the main chains, when it rose perpendicularly with a fearful explosion, and shattered the maintopmast to pieces. Still another instance of a sort of globular lightning was furnished by the great storm in Brittany in 1718, during which twenty-four church towers were damaged. Three globes of fire, each more than a yard in apparent diameter, fell at once upon a spire near Brest, destroying the church completely.

I need say little of the nature of lightning, since everybody is familiar with the story of Franklin and his kite. Every child knows that the flash is produced by the discharge of electricity accumulated in the clouds. But atmospheric electricity may become manifested in either of two different ways. When lightning is seen we observe what is called a "*disruptive* discharge;" while in the phenomenon best known as "St. Elmo's Fire" a "*glow* discharge" takes place. The latter is harmless, and rather rare. Occasionally its peculiar brushes or balls of fire tip the ends of masts and spars during storms at sea, as many as thirty of these flames having been seen on one vessel at the same time. Once in a while, too, it is produced on land. Troops of soldiers have been terrified at finding the tips of their lances or bayonets adorned with mysterious fires. Similar flames have decorated the hair and the finger ends of travelers caught in a storm above the snow line in the Alps. A wagon loaded with straw has been so electrified that every straw seemed to be in a light blaze. And at Plauzet in France the three points of the cross upon the church were seen surrounded by flame during every thunder-shower for twenty-seven consecutive years. But with these glow discharges we have little to do. The disruptive discharge concerns us, especially with regard to its effects.

These effects may be conveniently studied under two heads; first, the effect of the lightning upon the air through which it passes; secondly, its effect upon the object struck. The first of these heads needs to occupy our attention but very briefly. Often after a thunderstorm, especially near articles which have received the flash, a peculiar odor is perceived. This odor is commonly described as a "brimstone smell," and, taken in connection with the bluish, sulphurous color of the spark, has led people to imagine the actual presence of sulphur in the storm. But the odor really belongs to ozone, a modification of oxygen produced by the passage of an electric spark through that gas. Three volumes of oxygen have been condensed to two, and the product has the pungent perfume so well known.

But it is when we come to consider the effects produced by lightning upon the objects which it strikes that we reach the most interesting ground. Some of these effects have already been described or hinted at, and most of them are so familiar to everyone that they seem hardly to need extended notice. Yet the material is so abundant and so varied that it becomes easy to select many interesting illustrations of our subject. Take for instance the formation of "*fulgurites*" in the soil. When a flash of lightning strikes a bed of sand it penetrates downward with great force for many feet, partially melting the sand on the way. Deep vitrified tubes are thus formed, fragments of which can easily be preserved as curiosities. These are known as "*fulgurites.*"

The mechanical effects produced by lightning are often of the most stupendous character. In June, 1764, the steeple of St. Bride's in London was struck and damaged. A stone weighing seventy pounds was flung fifty yards, and an iron bar two feet long was broken in two, one piece of it being bent back upon itself at an angle of forty-five degrees. When the ship Le Patriote was struck in 1852, a block of wood weighing about one hundred and sixty pounds was torn out from the mast, and flung with its thicker end against a massive plank partition, a hundred paces away, so violently as to become firmly imbedded in the obstacle. A still more remarkable effect was produced when the ship Desirée was struck in Port Antonio harbor, Jamaica, in 1803. The maintopmast was broken in two, and the next morning one-half of it was found sticking in the mud on one side of the harbor, while the other half lay in a lumber yard upon the opposite shore. Again, the ship Rodney was struck by lightning in December, 1838. The top gallant and royal masts, fifty-three feet long and weighing about eight hundred pounds, entirely disappeared from the vessel, with the exception of the end of the royal mast. The sea was covered with chips and splinters, and the water alongside looked as if it had received all the refuse of a carpenter's shop. The mainmast was bound by twenty-six great iron hoops, and of these thirteen were burst asunder and thrown down upon the deck. Each hoop was half an inch thick and five inches wide.

These instances serve not only to illustrate the power of the stroke, but also the special liability of ships to receive it. Their long, slender masts, rising amid an almost level waste, offer the best possible work for the celestial fires. Indeed, a ship has been known to receive seven distinct flashes of lightning in the course of a few minutes. But the mechanical injury which a ship receives is not always its greatest damage. The electricity is apt to derange the compass, and play strange freaks with the chronometer. In consequence of these disturbances many a ship has been lost long after the danger seemed quite over. The packet ship New York, which was struck twice during a storm in the Gulf Stream in April, 1827, although it came safely to port, had particularly severe experiences. The waves ran very high, the vessel was surrounded by waterspouts, the rain was mingled with hailstones as large as filberts, and the lightning was flashing in all directions with simultaneous reports. The main discharge, which made the ship lurch so violently as to throw down people standing upon deck, fell on a pointed iron rod about four feet long, melting a few inches of its point. From this rod an iron chain one-fourth of an inch in diameter, a wholly inadequate conductor, descended to the water. This chain was knocked in pieces, and some of its links made to burn like a taper; while drops of melted iron fell to the deck setting fire to the woodwork wherever they touched. When the ship reached Liverpool it was found that the compass had been completely demagnetized; while on the other hand the steel work of the chronometer had been affected in the opposite manner, and the instrument accelerated over half an hour.

Powder magazines have also been made the particular favorites of lightning stroke. Many of them have been exploded by lightning, and thousands of lives lost. But no magazine protected by a suitable rod has ever been thus damaged. Such have been struck, but the shock has always been carried off harmlessly into the ground. The greatest disaster ever worked by lightning was doubtless that which happened at Brescia in 1769. The tower of St. Wazaire, having 207,600 pounds of gunpowder stowed beneath it, was struck and the powder fired. The tower rose bodily into the air, to return in a shower of stone; three thousand persons were killed, and about one-sixth of the city destroyed. Thirteen years later Fort Marlborough in Sumatra was struck, and four hundred barrels of powder exploded.

When living beings become the subjects of a flash of lightning the effects may vary quite considerably. In one case which happened about a year ago, a man's boots were torn from his feet by lightning, while he himself was only stunned. In another instance a lady was lying in bed, and the flash entered her window and singed away her hair without doing much other mischief. Other freaks of lightning were mentioned at the beginning of this article. When death results from such a stroke the body may present any one of a great number of appearances. It may be almost unmarked, or covered with burns. Livid welts sometimes appear upon it, as if the flesh had been bruised by a blow. Sometimes impressions, we might almost say photographs, of near objects are imprinted upon the skin. A man was killed by lightning at Zante in 1836, and marks of coins which he had carried in his pocket were found stamped upon his person. Yet the coins themselves were at a considerable distance from the marks! Such a death is probably painless. The electric shock moves so much more rapidly than the nervous impression that the victim dies before he has time to become conscious of injury. The lower animals seem to be in special danger from lightning. Instance after instance could be cited in which animals have been killed in close proximity to men while the latter remained unharmed. A ploughman was once ploughing with four oxen. Being struck by lightning, both man and beasts were overthrown. The man, however, was but slightly stunned, while two of the oxen were killed outright, and a third paralyzed. According to D'Abbadie, a single flash of lightning in Ethiopia destroyed two thousand sheep. Even the fish are not exempt from the paralyzing influence. When lightning falls upon the water many of its inmates are killed.

Fortunately the danger from lightning can be diminished by certain precautions. Some of these are quite generally known. For instance, one should always keep away from all large masses of metal, and from isolated trees. But although isolated trees are such dangerous companions during a thunderstorm, a man is but little exposed to risk in a dense forest. Trees may be struck in the latter, but they are less likely to be than when standing alone in the midst of a level plain. Safety is also found in deep narrow valleys or ravines. Lightning rarely reaches to the bottom of such places, but is scattered against their sides. The wearing of silk is said to be a safeguard against lightning, and the case of the church at Chateauneny les Moutiers in the Lower Alps has been cited to confirm this view. The church was struck during divine service on the 11th of July, 1819. Nine persons were killed outright, and eighty-two wounded. Two of the three officiating priests were injured, while the third, who wore a silken robe, escaped. One more fact is worth noticing in this connection. Whenever any number of men or animals standing in line are struck by lightning, the individuals at the ends of the line always suffer the most severely, Many examples of this are on record, but one will suffice for us. Thirty-two horses standing in line in their stalls were once struck by lightning, and thirty of them were knocked down. But only two were killed, and they formed the extremities of the line.

Although at first sight lightning seems to act so capriciously, leaping from point to point in the most irregular manner, and playing tricks more freakish than those of Puck, it yet moves in accordance with rigid, definite laws. Certain substances are better conductors of electricity than others, and even the same substance varies in its conducting power according to conditions. Differences of temperature, of internal structure, of form, and of surroundings, will cause two samples of copper or iron to conduct electricity very differently. And the lightning in its course, fickle and irresponsible as it seems, invariably follows that path in which conduction is the best. In other words, it moves in the line of *least resistance*, and never leaves that line under any provocation. A river would as soon leave its bed and flow along the tops of the hills. Upon this general principle the construction of lightning-rods is based. A line of least resistance is artificially furnished, through which the flash may pass harmlessly into the ground. Occasionally, however, buildings which were apparently protected by suitable conductors have been seriously damaged by lightning. Hence many intelligent persons have been led into a distrust of lightning-rods. Some have even asserted that the rods not only failed to protect buildings from the effects of a stroke, but actually attracted the danger. But the difficulty always has been that the offending conductors were not properly arranged, or, in short, did not ccnstitute the desired line of least resistanee. Many precautions have to be observed in the erection of lightning-rods, and to these we shall recur presently. Let us first see, however, whether there is evidence to warrant faith in good rods, and whether there is any truth in the notion that they increase the danger which they claim to avert.

Now a vast number of facts go to prove the efficacy of suitably arranged rods. The church at Antrasmes, for instance, was twice struck by lightning, the flash following both times in precisely the same track. Certain picture frames were ungilded, certain bars of metal destroyed, and the portraits of the saints blackened. A lightning conductor was finally applied to the building and it has not been struck since. The chapel of Count Orsini in Carinthia, standing in an exposed situation, was so frequently struck and injured that divine service was no longer celebrated within its walls. But in the year 1778 a conductor was applied. Since then the edifice has been struck less frequently than before, and every stroke has been carried harmlessly away. A similar instance is furnished by the tower of St. Mark at Venice, 340 feet high. This tower was repeatedly and seriously damaged by lightning until in 1766 a conductor was put on. Since that time no harm has been done. The tower has passed unscathed through every storm. Still another example is offered by the cathedral at Sienna, which was a favorite victim of the lightning. After a while, about the year 1777, a rod was attached to the building, causing much anxiety among the ignorant neighbors, who called it the "heretic rod." Soon, however, another stroke fell upon the cathedral and was rendered harmless by the dreaded conductor. The natives began to respectt the "heretic," and have since had no cause to alter this feeling. I will cite one more instance, in which a flash of lightning, after working serious mischief, was caught up and tamed by a metallic chain. The ship Hyacinth was struck in the Indian Ocean in 1833. The top gallant and topmasts, forty feet long and weighing nearly eight hundred pounds, were knocked into bundles of laths which scarcely held together. At the base of these masts the electricity encountered an iron chain, fifty feet in length and made of half inch metal, which communicated with a copper pipe running through the vessel. By these conductors the flash was carried off safely. After reaching them the flash could do no more harm.

The question whether buildings armed with lightning-rods are more likely than others to be struck, is partly answered by some of the foregoing examples. But, had I space, I might cite evidence of a more convincing character. The matter has been many times tested by houses standing closely together, one protected by a rod, and the other without defense. Time and time again the unprotected edifice has been struck and damaged, while its neighbor, which should, according to the popular theory, have attracted the lightning, escaped altogether. The same thing has also been observed at sea. Two ships, the one equipped with conductors and the other not, have been exposed to a storm scarcely half a cable's length apart. And the flash has fallen, not upon the attracting conductor, but upon the masts of the unarmed vessel. In fact, nothing is more certain than that lightning rods do not increase the danger from lightning.

That a lightning conductor may be adequate to its purpose several things are needful. The rod must be made of proper material. It must be large enough to carry off any stroke which may fall upon it. It must be continuous throughout, it must terminate in a proper locality, and it must be in part at least protected against rust. Negligence on one of these points might render the whole affair worthless.

First, of what material should the rod be made? Of course, the better the conducting power of the material, the more efficient the rod. Now, but two metals are practically available, namely copper and iron, the first of these conducting electricity about eight times as well as the other. Copper, then, is the best material. Next to copper ranks the so-called "galvanized iron," iron coated with zinc. The latter metal not only conducts better than iron, but protects the iron from rust. Common iron is the worst material of the three. The size of the rod is the next consideration. If copper alone is used, a half-inch bar will carry off any stroke which is ever likely to fall in our latitudes. Of galvanized iron a three-fourths inch rod should be used, but of common iron nothing less than an inch in diameter is a perfect protection.

Now, how shall the rod be constructed? Here we come into collision with certain popular whims. It is common to see rods carefully separated from the buildings they are intended to protect by neat little insulators of glass. These are utterly useless. An electrical spark which could break through the thousand or more feet of air intervening between the earth and the clouds would pay but little respect to the inch or so of space occupied by the insulator. Besides, if the path of least resistance lies in the lightning-rod the flash will not leave it for any more difficult channel. Another popular whim concerns the shape of the rod, many people having an idea that a spiral form is the best. This is a matter of no importance, and need be considered no farther. Let us begin at the tip of our rod. This needs to be protected from rust, and also to some extent against fusion. The latter difficulty may be gotten over by forking the tips, so that a flash falling upon it shall be divided into several parts. The other object is to be attained in several ways. The tip may be made either of platinum or aluminum, or it may be plated with nickel, or simply gilded. The last-named plan is the best and cheapest. The gilding costs but little, does not tarnish, and affords a surface of actually higher conducting power than either iron, aluminum, platinum, nickel, or zinc. Gold ranks next to copper in the scale of conductivity, silver standing at the head of the list. A silver tip, however, would be bad, for many reasons which need not be given here. As regards the body of the rod, this should be perfectly continuous throughout. No breaks should occur in it. Wherever joints are necessary the continuity of the conductor should be preserved by soldering. The lower extremity of the rod must be arranged with great care, and ought to extend several feet beyond where it leaves the building. If possible, it should terminate in a spring, well, or sheet of water, by means of which the electric shock may be scattered and lost. But by no means ought it to dip into a closed cistern or cesspool. A discharge of lightning, prisoned in such a place between stone walls, will send them asunder in order to escape. Ordinarily it is well enough to divide the lower extremity of a rod into several branches, and allow them to run about four feet deep into moist earth. By making the rod terminate directly under the waterspout, the earth into which it plunges may be thoroughly drenched at every shower. Another good plan is to fill a pit with several bushels of charcoal, which, previously heated to redness, has been suddenly quenched. The forked termination of the conductor is then buried in this pit. But such precaution is needed only where there is but very little moisture in the soil.

One more thing is needed. If several rods are placed upon an edifice, they should be connected with one another by horizontal rods like themselves. And they should also be connected directly with all large masses of metal upon the exterior of the building, such as gutters, spouts, cornices, crestings, balconies, or metallic roofings. Thus the line of least resistance may be made to communicate with nearly all parts of a wooden house, and the protection rendered more sure and complete.

Let me sum up these directions, fitting them for an ordinary dwelling house of moderate expense. I will not give a description of an absolutely perfect lightning-rod, but simply of one which will serve all common purposes. Make it of three-quarter inch galvanized iron, and let the gilded tip project as much as two feet above the ridge-pole or chimney top. See that it connects with the proper metallic masses, render it continuous to the ground, and conduct its termination, divided into three branches, either into a body of water, or else let it plunge four feet below the surface beneath your water-spout. With two such rods any dwelling of common size may be considered proof against the lightning.

Some trials were made lately on the Seine, at Paris, to determine the best way of breaking up river ice with dynamite. Bernard and Lay, assisted by two specialists, Flegy and Streits, of the Nobel Dynamite Company, directed the operations and recorded the results. The best effect was obtained by placing three cartridges of 406 grammes of dynamite beneath the ice, each connected with an electric machine on the bank of the river. When the cartridges were exploded it was found that the ice was shattered a distance of about eighty meters and through a width of from five to six meters. The pieces of the fractured ice were, moreover, found to be very small, and easily carried down stream past obstructions such as bridge piers.

The amphioxus, a fish-shaped animal of a very low grade of development which affords Haeckel one of his firmest stepping-stones in the lively work on evolution, has been the subject of very interesting observations on the part of Henry J. Rice, at Fort Wool, on the Chesapeake. He had the good fortune to find two males, a ripe female and twenty young. The animal stands on debatable ground between the vertebrates and invertebrates, and received its name from its shape. Amphioxus is the Greek of Mr. Yarrel for "sharp at both ends." Descriptions of the habits, structure and development of this curious primitive animal are being issued in the *American Naturalist* by Mr. Rice.

PHILOSOPHY.

CHOICE AND CHANCE.

BY FRANCIS E. NIPHER,
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In a lecture delivered in this city during last winter, and entitled "Thoughts on our Conceptions of Physical Law," some points were lightly touched which it seems desirable to develop more at length. For the sake of brevity, some of the statements which will be made have assumed a slightly dogmatic form. They are not so intended. Be kind enough to regard them as thoughts of the truth of which we are in some cases all more or less uncertain, which are submitted to the judgment of sober minds. It does not make a statement true if the whole world affirms it; the world has often blundered. This consideration suggests the frame of mind in which we should approach difficult subjects where men are likely to differ in opinion. He who comes to debate—to defend previously formed ideas —is at a disadvantage. It is difficult for such persons to place a proper value on the thoughts of others. In this manner the chances for error are increased. The method of the scientific man should be different. If he investigates phenomena, he seeks to use methods of experiment which eliminate from his results the personal bias of his own mind. He must learn to have no preference for one fact over another. He must learn to have no anxiety about the result. He must learn to be stringently honest with himself—a most difficult thing. If he works inductively, he should try to find out what *all* of the facts teach. If he has occasion to frame an hypothesis, and wishes to work deductively, then his work is, *not to demonstrate*, but to *test* the truth of his hypothesis. In the debating school, young men are taught to defend assumed positions. In the Academy of Science it should be our only object to search for truth. When we differ it is better to *think*, rather than to dispute.

In the transaction of business we are constantly estimating chances, or probabilities. All our predictions for the future, even when based on the experience of centuries, are simply more or less probable—in no case certain. We cannot be absolutely certain that the sun will rise at its accustomed time to-morrow. It is wholly in accord with human experience and with the theory of probability, that very unexpected things will occasionally happen.

If we were to learn the contents of an urn, containing a million balls, by drawing the balls one by one, replacing them each time, we might, in course of time, gain a general idea of the contents; thus if 100,000 draws gave each a

*Delivered before the Kansas City Academy of Science, Feb. 18th, 1880.

white ball, we would properly decide that white balls are greatly in the majority, but we might continue for a century without drawing the single black ball that the urn might contain.

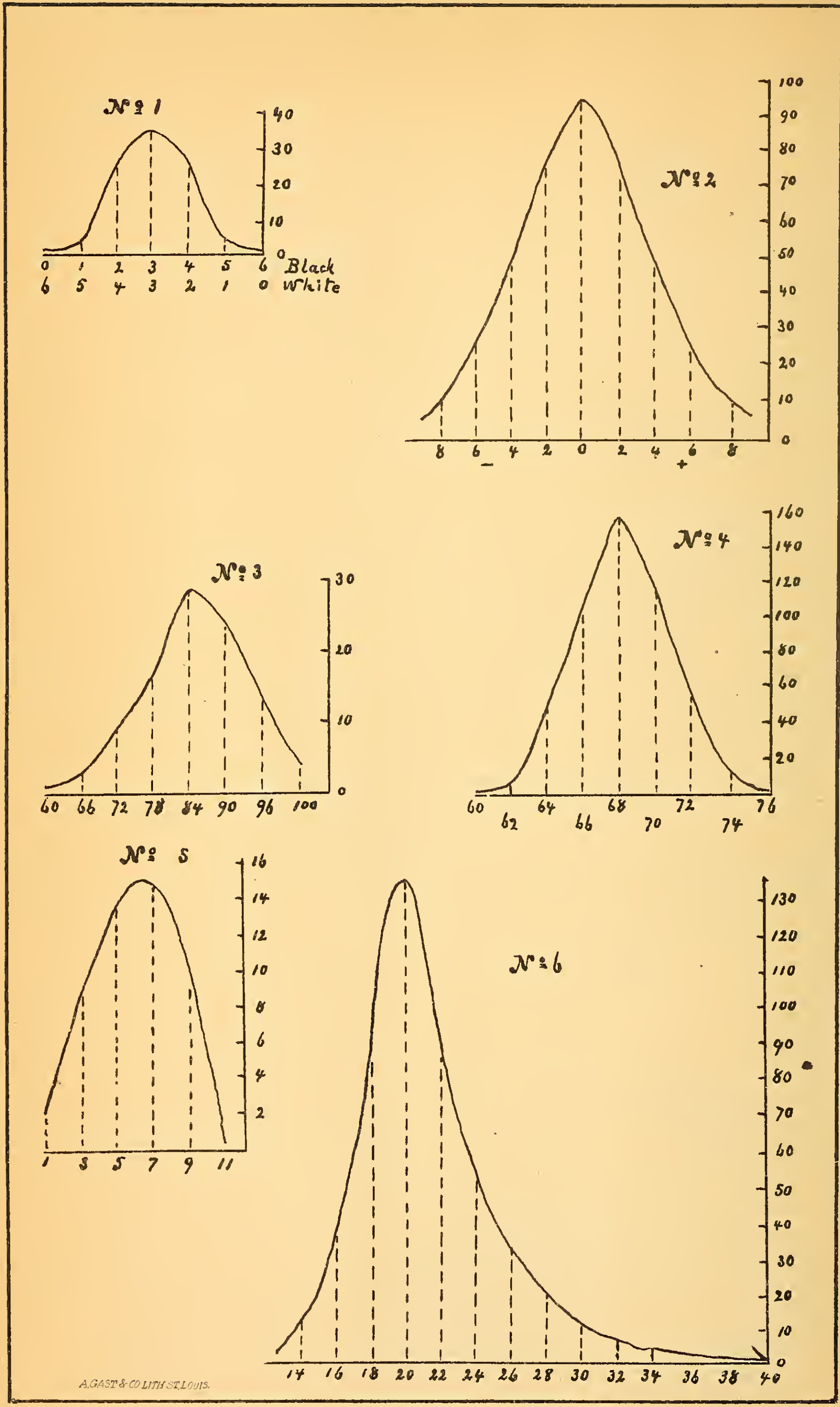
So it is with all human experience in this world. If we could range at will through space and time, we might well be surprised, as Tolver Preston has suggested, by the greatly varying conditions which we might find in other and unknown parts of the all-embracing universe; just as a minute being, inhabiting for a brief moment a single atom of a gas, and who might imagine that he had become quite familiar with his little world, would find much to learn, could he extend his observations over a longer time, or over a wider space. He would then find the greatest variety in the motions of neighboring molecules of the gas. Some moving with extreme slowness—others with extreme velocity—the same differences being observed in the velocities of their rotations. Moreover these velocities are being constantly changed, by collision of neighboring molecules—collisions which must often result in the separation of the molecules into their constituent atoms.

It may well be, as Preston ingeniously suggests, that all this is repeated on an immensely grander scale. Perhaps our solar system is rushing through space, with a motion compared with which the relative motions of its various parts are utterly insignificant. Collisions, instead of happening to each atom many millions of times per second, as in the case of gases, are here separated by immensely long intervals, and it is a minute portion of one of these intervals which represents the life-time of our humanity upon one of the atoms of the universe. Possibly we are not yet acquainted with the average conditions of the universe, our attention being confined, for a comparatively brief interval, to a few of the atoms which for the present are nearest to us.

We are able to predict the *probable* history of our earth, in the comparatively near future, but we know almost nothing of what the remote future may bring. Here we have fairly entered the domain of *chance*, which is the domain of human ignorance.

It is essential to bear in mind that probability is a thing which belongs, not to the events which are probable, but to the mind, depending as stated upon our knowledge, or rather upon what we think we know.

This is clearly shown by the fact that different persons may regard the same event with very different degrees of probability; for example: A thinks he saw a ball dropped into a box, and thinks he knows that it is yet there. B is certain that it was a juggler's trick, and that the box is empty. C did not see the act and has no opinion in the matter. The conclusions which these men will form will depend upon their previous experiences, their opportunities for observation and their native ability. Their *confidence* in their conclusions is not necessarily dependent upon the real facts. Or, to take another case cited by Jevons: "A steamer is missing, and certain workmen in a dock-yard, knowing that she is poorly built, believe she is lost. The public is informed that she is well built,


No 1
0 1 2 3 4 5 6 Black
6 5 4 3 2 1 0 White
0 10 20 30 40
No 2
8 6 4 2 0 2 4 6 8
− +
0 10 20 30 40 50 60 70 80 90 100
No 3
60 66 72 78 84 90 96 100
0 10 20 30
No 4
60 62 64 66 68 70 72 74 76
20 40 60 80 100 120 140 160
No 5
1 3 5 7 9 11
2 4 6 8 10 12 14 16
No 6
14 16 18 20 22 24 26 28 30 32 34 36 38 40
0 10 20 30 40 50 60 70 80 90 100 110 120 130
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and is probably safe, although delayed. In the event itself there is no uncertainty. The vessel has either sunk or not. Nevertheless the probabilities will vary with different persons, and in the same person from day to day, as information is received in regard to storms at sea, signs of wreck picked up, the trustworthiness of her officers, etc." Finally after all have united in believing the vessel lost, she sails into port. While the general opinion is still the same, a few on land *know* that she is safe. Those on the vessel have never been in doubt about it.

In order to understand more clearly the application and importance of the Theory of Probability, let us take a single example:

Let us suppose that we have an urn, containing a large number of equal balls, and for simplicity, let us suppose that half are white, the others black. Draw from the urn any number of balls at once, say six, (of course without choosing) and repeat this drawing a large number of times (say 1,000) replacing the balls and shaking them up each time. Set down each time the number of white balls drawn. There are seven possible chances, viz:

6	white	and	0	black.
5	"	"	1	"
4	"	"	2	"
3	"	"	3	"
2	"	"	4	"
1	"	"	5	"
0	"	"	6	"

We all know something in regard to the probability in each of these cases. We should meet least frequently with the two extreme cases—all white and all black—and in the long run we should meet with one as many times as with the other, since there is nothing in color or lack of color which could affect the chances in drawing.

The following table gives the distribution of the number of draws out of 100 for each of the possible cases. The greater the number of draws, the more nearly these values would be obtained:

Chances.				No. of Times.
6	White.	0	Black.	2
5	"	1	"	3
4	"	2	"	27
3	"	3	"	36
2	"	4	"	27
1	"	5	"	3
0	"	6	"	2
				100

That is, we should draw 6 white balls twice out of each hundred draws, etc. These numbers can be quite accurately determined by 1,000 draws, if the urn contain several hundred balls *

*These numbers represent the successive terms of the expanded binomial $(\frac{1}{2} \text{ plus } \frac{1}{2})^6$ where the sum of the terms is taken as 100, and where the exponent represents the number of balls drawn at once.

In order to represent these chances to the eye, divide the horizontal line of Fig. 1 into six equal parts, laying off at right angles to it, and at the points of division, the vertical lines whose lengths are proportional to the number of draws for the various cases. The fact that the continuous curve passed through the extremities of these vertical lines, is symmetric on each side of the middle, means that white balls and black balls stand an equal chance of being drawn. If the black balls were less in number or were smaller, and had a tendency to sink to the bottom, then the curve would be unsymmetric, the probability being in favor of the white balls.*

We come now to the application of what we have here learned.

If any dimension—for instance the length of an iron rod—be measured with the greatest attainable accuracy, the successive measurements will, in general, all disagree. Taking a great many such measurements, all differing from each other, which shall we adopt as the true value? We may assume that all the observations are made with equal care; one can have no preference over another. The fact that they all disagree, and that the tendency to disagree increases with the delicacy of the determination, is sufficient to show that no one observation can be adopted as the true value; and further, that it is impossible for us ever to determine the true value. The best that we can do is to take the mean of all determinations. To this mean we give greater or less weight, according as the separate determination more or less nearly approximates to the mean.

In order to illustrate this point we may take the 470 determinations of the right ascension of the star Sirius, as made by the astronomer Bradley. In the following table d represents the difference between the observation and the mean of all observations (in tenths of a second); n represents the number of times the respective differences were found to occur.

The positive and negative distances are thrown together without regard to sign:

d.	n.
1	94
2	88
3	78
4	58
5	51
6	36
7	26
8	14
9	10
10	7
11 and over	8

i. e., out of 470 observations, 94 showed differences of less than 1-10 second, 88 fell between 1-10 and 2-10, etc. As was to have been expected, the greater

*In this case the terms of the binomial would be no longer equal.

"errors" are met less frequently than the smaller ones. The results are represented in Fig. 2 of the plate where the values (d) are laid off on the horizontal line and estimated from the point marked zero (0).

The line 0 2 represents a certain positive "error," and the distance from 2 to the curve represents the number of times it is met in 100 observations. 0 2 in in the opposite direction represents an equal negative "error," while the vertical line at the point 2 represents its frequency. It can here be observed how the frequency diminishes, as the magnitude of the error increases, until finally the curve intersects the base line, indicating that larger "errors" do not occur.*

The law expressing the divergence of these values from the mean is the same as that which expresses the probability in drawing balls from an urn containing an equal number of white and black balls.

In the case supposed, the differences are due to imperfections in the instruments and in the observer, to unknown variations in temperature, etc.

Let us consider another case, which will perhaps aid us in gaining a clear idea of the subject. Let us suppose that we have a rifle mounted like a swivel-gun, so that it can turn only in a horizontal plane. In the same plane let a thin, hard board be placed with its edge turned toward the gun If we fire at a certain point in the edge of the board, a sufficient number of times, we should cut into the board a gap which would be bounded by a curve precisely like the one before given. In case of a good marksman, the gap would be narrow and deep. (Fig. 3.) With an equal number of shots a very bad marksman would cut out a wide and shallow curve, while if all kinds of people were allowed to try their skill, we should get the curve of average human marksmanship. The errors of the former case are here represented by deviations from the mark, small deviations being most common. It might be said that these deviations are caused by chance. They are in fact the result of unknown but purely mechanical causes, such as gusts of wind, irregularities of the balls, fouling of the gun, or deviations caused by pulling the trigger. Chance is neither a thing nor a cause; it is simply a name to cover over ignorance of the real causes; it is a matter of experience, that a great number of simultaneously acting and constantly varying causes, affect the result in such a regular way that we can predict in a statistical way, the frequency of different errors or deviations. When these causes are unknown, we say that it is a matter of chance.

A curve of this kind would at once exhibit the success of any person in shooting at a mark, and it seems probable that the success with which we accomplish any other thing involving a great number of acts, would be represented by a similar curve.

We have a large class of people in this world who aim to be as good as other people. Some of them resemble the good marksman. Their deeds all lie very close to the mark. They are never very good and never very bad; but always "indifferent honest." Others are like wild shooters. If we could grade their acts, we should find some decidedly bad, others far above the average of good

*As the mean value is not the true value, it is not strictly correct to call these differences "errors."

ness, while a greater number would be ranked about average. The shallow curve of the bad marksman is suggested. The two cases are, however, not exactly alike, for a good shot is one which lies nearest to the mark, while the virtue of an act is judged by a higher standard than the supposed mark. Hence the marksman would always aim at the mark, while the man who wishes to be as good as other people, usually tries to make sure of having enough of good deeds by putting in a few extra good ones toward the last—that is, he changes his aim somewhat in order to polish up his curve into satisfactory shape.

That this same law of probability applies to the distribution of mental ability in a mass of people is well known. Comparatively few people are brilliant and comparatively few are stupid (the opportunities being supposed equal). The great majority of people rank near the average. Among others, Professor Hinrichs has investigated this subject, by a comparison of class markings at the State University of Iowa. The results here given are from the markings of the Freshman class in Physics.

The results are obtained by combining independent markings for recitation, notes on lectures, and laboratory work, as determined by three different instructors. The greatest pains were taken to secure just markings, the valuations being repeated several times. The best students were marked 100, and below 65 was counted a failure

In the following table the numbers are grouped in fives, 90 per cent. including 88 to 92, inclusive, etc.

The total number of students in the class was 287, and the results agree as closely with the theoretical values as would those obtained by making 287 draws from an urn containing black and white balls in equal number:

Standing	100	96	90	84	78	72	66	60	Total.
Number of Students	13	53	57	80	45	24	12	3	287
No. per 100	4.5	18.5	19.9	28.0	15.7	8.4	4.2	1.0	100

This shows that the chances that the standing of a student will fall in the group marked 84, is 80-287 or 28-100, or a little less than one-third. This is the grade of the average student, and here the greater number are ranked. For higher or lower markings, the number of students is less, the fewest numbers being at the extremes of excellence. It will be observed that in this case the numbers are not quite the same for grades equally removed from 80 per cent., the probability being somewhat in favor of the higher markings. This might possibly be different if a greater number of cases were examined. It is also to be remembered that such students are a selected class of society, and if all of the young people of a state were to be thus examined, the grade would probably be somewhat lower, and the numbers would perhaps show a more symmetrical arrangement.

We have previously discussed the mental divergence of men from the norma or average man. As might be expected, the same law holds in regard to physical dimensions, as was first shown by Quetelet.

For any given nation at any given time, there is a certain typical or average man, whose dimensions could be obtained by taking the average dimensions of all the men of the nation. Mr. Galton has even shown us how to obtain his photograph.* This is done by taking photographs of a large number of men, making the photographs of the proper size relatively, and taken in similar positions, although no great exactness is necessary.

Each photograph is then exposed to the camera in such a way that all the faces are re-photographed successively on a common plate. The best method of doing this, is to pin the first photograph to a block which can be set up in front of the camera. Its position there is fixed by nails driven into the base board, so that the block may be removed andreplaced in exactly the same position. In order that the next picture may be exposed in the same way, an ivory or wooden scale, with a beveled edge, is placed with its edge tangent to the iris of the eyes, and with any division of the scale bisecting the nose. The position of the ruler is then fixed by guide nails or pins, driven into the block. This enables each photograph to be placed in the same position on the block, and the block to be always placed in the same position before the camera.

Each portrait is then exposed for a few seconds to the same plate, so that when it is finally developed a generalized picture is obtained.

It is not a portrait of any one person; it represents a type, in which those points which are common, are emphasized, and the purely individual peculiarities are almost wholly suppressed. The greater the number of component pictures the more truly will the resulting composite picture represent a type. We present here a composite picture from three criminals. It is from a wood cut in Mr. Galton's paper. As Mr. Galton remarks, "the villainous irregularities of the originals have disappeared, and the common humanity that underlies them has prevailed. This picture represents then, not so much the criminal, as the man who is liable to commit crime." [Portraits of nine members of the university faculty were also shown, together with the results obtained, by combining them in various groups.] It is evident that this work of Mr. Galton is an immense step in the study of race characteristics, and as has been suggested by him, it will be of immense service to art in enabling artists to study various types of beauty.

These portraits are shown here to aid you in forming a definite idea of what is meant by an average or typical man.

If, however, we wish to get the *dimensions* of the average man, we must resort to physical measurements. In this way it was determined that the height of the American soldier is 68 inches; his chest measurement is 35 inches, etc. These determinations were derived from the measurements of 26,000 soldiers of the Union army. The greater number of the men approximate the mean height, the number taller and shorter diminishing with great regularity to the dwarfs of 5 feet, and the giants of 6 feet 4 inches.

*Nature, Vol. 13, p. 95.

The number of persons in each 1000, of the various intermediate heights, is given in the following table:*

H	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
N	1	1	2	20	48	75	117	134	157	140	121	80	57	26	13	5	2

The numbers here are the same as we should get in the various chances in drawing 30 balls from an urn, containing an equal number of white and black.

The curve (See Fig. 4) representing the above observations, is the same as that which might be made by a marksman in shooting at a mark. If we were to determine the heights of all the men in a nation for each year of life, we should get a very interesting series of curves. Take all male children of one year of age; they differ comparatively little in height, or in mental power. They all approximate closely to the average. If we were to calculate the divergence from the average for 1000 cases, we should get a curve resembling the curve of an accurate marksman. It would be deep and narrow. Examining children of greater ages, say 10 years, we should find that they have begun to diverge from each other. Circumstances have arrested the development of some, and have caused others to surpass the average. In 1000 cases we shall therefore have a less number of persons of average dimensions.

The curve for this case would be like that formed by a poor marksman, the curve becoming more and more shallow, as we come to higher ages.

If we could grade the various members of society according to their opinions upon any subject which agitates the whole of society, we should find some such distribution as the one just examined. We should find two extreme parties, (corresponding to the dwarfs and giants of the previous case) comparatively few in numbers, but active, resolute, aggressive. Between, we have the great mass of respectable society, interested in other things, and giving little real thought to the matter; anxious to hold proper views, and therefore holding average views as the safest; pulled upon by the opposing workers, and yielding slowly to the resultant force, and thus, by reason of its immense mass, securing comparative stability and order against the rough jostlings of the more active, but less ponderous extremes.

According to the investigations of Horstman, Hinrichs and others, the velocity of chemical reactions in time, is represented by this law. It has been proved theoretically in some cases, and experiment has confirmed the conclusion.

If we throw small fragments of zinc into sulphuric acid, we get an evolution of hydrogen gas. At first the velocity of evolution is very small; it increases, however, and finally reaches a maximum. Thereafter the velocity diminishes

*Quetelet—Anthopoimetrie, p. 252.

until it finally ceases. Fig. 5 represents an actual experiment. The time in minutes is laid off on the horizontal line, while the velocity of evolution of the gas at various moments is represented by the distances from the base line to the curve. Hinrichs has shown from the experiments of Guldberg and Wage, that the probability curve represents this case very closely. Operations based upon heat conform more closely to this law, as there all the particles have a more equal chance of being acted upon—an essential condition. In society there are manifold operations which closely resemble this. Almost every year society is agitated by some idea, which at first interests very few people, but the interest gradually grows, and apparently with considerable regularity, reaching finally a culminating point, and then gradually dying out. The base-ball and blue-glass fever and the zig-zag puzzle may be mentioned as cases of this kind, and other cases will readily suggest themselves. Movements in society which are properly classed as reforms, usually make slow progress at first. The case is, however, advocated by a few tireless enthusiasts, like Wm. Lloyd Garrison, and after dragging along for years, the matter suddenly makes rapid progress, and is abruptly settled.

In other movements of less momen, tlike the adoption of some fashion in dress, the matter makes great headway at first, rapidly receiving the assent and adoption of the great mass of people, a few laggards bringing up the rear.

These cases, which are symmetrically related to each other, would be represented by the chances in drawing balls from an urn containing unequal numbers of white and black balls.

Another well-known case lies at the base of all life insurance. We can predict with great confidence how many persons out of 1000 who are 10, 20, 30 or 40 years of age will live through the next year. This case is so well known, that we will discuss a somewhat more interesting one, which has been investigated by Dr. Granville. I refer to the probability of marriage. Dr. Granville determined in some manner the age at which 876 English women were married. The values thus determined are given in the following table, where the number marrying at the various ages from 13 to 40 is given :

Age.	13	14	15	16	17	18	19	20	21	22	23	24	25
No.	3	11	16	43	45	76	115	118	86	85	59	53	36

Age.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40 . .
No.	24	28	22	17	9	7	5	7	5	2	0	2	0	1	0 . .

From such values, extended to a greater number of cases, we might easily deduce the probability of marriage at various ages. In this table, those who do not marry at all, are not included. These facts are represented in Fig. 6 of the plate.

This operation reminds us very strongly of the chemical re-action. The hydrogen is liberated, at first slowly, the velocity increasing for a time, and gradually diminishing to zero. If we consider the velocity of marriage, the same general relation exists. Starting with 1000 young ladies at 13 years of age, three of the young ladies marry during this year. The velocity of marriage increases until during the 19th year the number is 131, the maximum velocity of 134 per year being reached at 20. Half of them are now married, and from this time these interesting creatures drop off much less rapidly. At the age of 30, only 10 out of 1000 marry, while at the age of 40, the chances for a *first* marriage are practically gone. Those who have had previous experiences of this kind might perhaps manage to make some arrangement even then.

It will be observed that the chances do not diminish symmetrically on opposite sides of the maximum. In the operation of drawing balls, this would be represented by the case where the number of white balls was say greater than the number of black, making the probabilities less in drawing black.

We are thus able to calculate how many times out of 100 draws we shall draw all white balls from an urn, but we cannot predict what will be the result of any particular draw. We can predict how many times in 100 measurements a person will make an error of a thousandth of an inch, but we cannot predict what the error will be in any particular case. We can predict how many shots a certain marksman will put into a circle two inches in diameter, but we cannot predict where any one shot will strike. In a class of sufficient dimensions we may be able to predict how many will have mental ability enough to reach a mark of 90 per cent., but we cannot discuss the infinite number of subtile influences that have been acting on any one person, giving to each its proper weight; we cannot repeat the same thing for his ancestors, tracing back from him through the centuries the numberless divergent threads of inherited tendencies, and thus give a complete reason for the ability and inclination to learn, which any given student manifests. We cannot tell why any person varies an inch in height from the average of his kind; nor can we give a complete reason for similar divergencies in moral stature. Quetelet has shown that we can predict how many men will commit murder or suicide in Paris during a year, but we cannot discuss the matter in such a way as to enable us to predict who the unfortunates will be, at what moment they will decide to commit the fatal act, and exactly what they severally lacked, mentally or physically, the possession of which would have changed their decision.

But we can imagine a being, who shall be mentally able to do all this; to give a complete solution of any problem that the human mind can propose. The causes for the breaking down of a railroad bridge can be given by a competent engineer, and he may be able to detect the weak points in the theory of its construction: he may be able to guard in part against flaws in the material. In the same way, and in a much more perfect manner, an infinite mind could discuss the breaking down of a human resolution, under the strain of temptation, and could give a precise reason for the physical, mental, or moral divergence of any given man, from the average man.

The equations involved in this discussion must be sufficiently comprehensive to include the surroundings of each man, as well as the man himself. The decis ion a man will reach, by reason of all influences brought to bear on him, depends upon the *man*, and upon the *intensity* of *the influence*, just as the interaction between two planets depends upon *both* of the acting bodies. That is to say, in the equations there will appear certain constants the values of which will differ with different men, just as in building a bridge, the values of certain constants in the formulæ depend upon the kind of material used. In the former case the value of these constants will be determined by the previous experiences of the man upon his inherited ability, tendencies, etc. We recognize all this in the popular saying, that different men under the same influences act differently, just as different beams of wood under a given tension, would act differently. Some would safely carry a load under which others would break down at once. The values of these constants may change for the same man, as when experience in any emergency causes him to resolve to do differently next time.

Our equations must then enable an infinite mind to trace out, in such a manner that they could be predicted, all such events in the life history of a man as these: On a certain day and hour he will decide to take a pleasure walk, influenced by motives which we need not consider. Passing near the river bank, he sees a fellow-man struggling in the water. At once various mental forces are brought into action. He has, during his whole life, found pleasure in deeds of benevolence. For this trait in his character there is an adequate cause, but we need not consider it. His first impulse is to rush in and save the drowning man. The fact that he is an expert swimmer tends to influence him in the same direction. But he also knows that his lungs are in feeble condition, and, moreover, he is overheated by vigorous walking, he is far from help, and the water and air are cold. The drowning man is strong, and thoroughly frightened. The events press for an immediate decision, and this may also have its influence in determining what the final decision will be. Some of us think that a higher power may also influence him in some way. All these influences, brought to bear on this man's mind, resemble a system of parallel and opposing forces acting upon a particle of matter, only, the relative *magnitude* of these forces will be different, for different men. As in the one case there will be a certain resultant, in the direction of which the mass will move, so in the other case, there will be a resultant—a decision, which will bring about a corresponding line of action. For a time, his judgment may hold him in equilibrium, as previous experience causes him to act with prudence. The discovery that the drowning man is his son, would probably determine his decision at once, and the discovery of a rope upon the bank, would attach upon his mind another intensely acting force. During his moments of suspense, the intensity of these forces would be constantly varying, as one after another consideration presents itself for the moment prominently in his mind. The infinite mind, fully learned in mathematics and mental philosophy, could predict at what moment the man would decide to rush in, and by continuing the calculation, might find that as a result, his respiration and circulation would be affected in a certain way, a large secretion would form in his lungs, and that at a certain moment, in a fit of coughing, it is calculated that a certain point in one of the large blood vessels would be strained a few grains more than it would be able to endure, resulting in its rupture.

In the region over which we have now been traveling, all questions of probability have vanished. Everything has become certain. In a world full of such minds, many kinds of business—as life insurance—could not be carried on, as the individual risks would be perfectly known.

Our reasoning is all based on the assumption, that all events, whether in the world of matter or of mind, are preceded by events which may be taken as *direct and adequate causes.* Even when a man willfully decides to do an unwise and an unreasonable thing, there is a cause for it, and the existence of the effect is of itself sufficient evidence of the sufficiency of the cause. That is, there must be some reason why a man decides against reason. A rule which seems to be quite general is, that in any given case (so far as reasonable motives enter into consideration) we decide to do that which we then think will give us on the whole most pleasure or least pain, often deciding, however, to give up a greater pleasure, to be enjoyed only in the future, for a lesser one, to be enjoyed immediately, precisely as we sometimes allow a note to be discounted, in order that we may realize upon it at once. The actions may in many cases be unaccompanied with any elaborate reasoning, and may be without special reference to consequences, as when in consequence of previous reasoning of himself, or his ancestors, a man may form the *habit* of doing certain things. In such cases the action seems to be largely automatic. A man's ideas of pleasure may be very low and vulgar, he may possess very poor judgment, and foolishly discount his happiness for too high a per cent., and the question arises then, why is he so? We cannot answer, except in general terms. He has inherited certain peculiarities, certain tendencies. He may have been placed in surroundings not favorable to mental and moral growth, and one of these inherited peculiarities may be the lack of a *desire* to cultivate his finer feelings, just as others may evince a lack of desire to cultivate mathematics, or music, or chemistry. Even when placed under the most favorable auspices, the mathematician, the musician, the chemist or the moralist, fail to arouse in him the least sign of appreciation. The lack of appreciation is fatal to success in mathematics; why should it not be equally fatal in morals? Precisely what it is that such men lack, whether it be merely a matter of nerve tissue, or whether something infinitely deeper is involved, is a problem, the complete solution of which is merely a matter of ability.

The fact that our most earnest thinkers on such subjects come to such widely different conclusions, makes it probable that we are all incapable of dealing with the subject in any exact manner. Whatever we may think of ourselves, and our reasonings, we are probably all one-sided, and take altogether narrow and incomplete views of the subject.

The difficulty of reaching precise results is increased by the impossibility of our making precise measurements of the influences about which we are talking.

A person of rather limited information, who might happen to observe that his butcher is sending him less and less beef for a quarter of a dollar, and who might incidentally learn that the earth's mass is being constantly increased by the fall of meteoric matter upon its surface, might possibly argue that this apparent rise in beef is due to the fact that it requires less beef to pull the index of the spring-balance down to the one pound mark. The reasoning is perfectly correct, but when we come to measure the *intensity* of the influence it is found entirely insignificant. Such a person would need to learn that there are many other potent influences that affect the price of beef.

So in the difficult subjects which we have been discussing.

There may be secret springs in the human mechanism of which we are all wholly ignorant, and we may attach undue importance to many influcnces. However this may be, it seems to me possible to imagine beings of a higher order of intelligence, having perfect knowledge of men physically, mentally, morally and spiritually, and capable of predicting all our future surroundings, and all our future decisions. Of course this has nothing whatever to do with the *nature* of mental or spiritual operations. We may agree that they are as unlike "merely mechanical" operations as we please. The infinite Being, particularly if He be assumed to be a Creator, can trace out the future of a man with much greater precision than a "mere" manufacturer can trace out the future of a watch. Although the latter may be able to predict approximately what his watch will do, *if properly treated*, he cannot know how it will be treated. With infinitely greater precision an infinite mind could trace out the totally different class of phenomena, known as spiritual and mental operations. He would know that at a certain moment some one of us will be surrounded with peculiar dangers and temptation; he would know whether the man will be able to deliver himself without external aid, (from either a human or a superhuman source) and he would know whether or not this aid will be given, and the precise effect which it will produce. If there are beings who *know* the future orbits of men, as astromomers know approximately the future orbits of planets, the question at once arises, in what sense are men free to decide, as distinguished from the freedom of a planet to move? If *any* being knows absolutely that an event will happen, seeing clearly *all* of the acting causes, is there a single possibility that it may not happen? Would not its failure to happen be taken as proof positive that there was no such knowledge as was assumed?

It is of course possible for me to decide to do a thing, *and* to decide not to do it, but it is not possbile to do these things simultaneously. They must come successively, and each decision would be determined by the mental forces before discussed. Each decision could be predicted. One of these forces might arise from a desire to avoid the conclusions which here seem to force themselves upon us, and lead to an attempt to exert the mind in a purely arbitrary manner.

This view of the matter is from the standpoint of perfect knowledge. From our standpoint we can only observe that men differ from each other in height, in weight, in mental or physical strength, in moral worth, and that they appear to group themselves in a definite way about the average man.

If we now attempt to grade men according to the wisdom which they exhibit in their choices, we should find comparatively few people exhibiting the highest forms of wisdom; the representatives of extreme foolishness would probably be more numerous. Between these extremes we should have all possible grades, in which the mass of society would be represented. It is hardly probable that the resulting curve would be symmetric. The greater chances would probably be in favor of foolishness, corresponding in the drawing of balls from an urn, to the case where the number of white balls is greater or less than the number of black. That is, from the human standpoint, the wisdom of human choice, in the aggregate, appears to be a matter of chance, in the same sense in which it is a matter of chance where shots will strike a target.

From the higher standpoint of perfect knowledge no element of chance can enter. Each choice, whether wise or foolish, whether the reasoning which has led to it be logical or not, is determined by perfectly definite causes, admitting of precise mathematical discussion.

In what way can we then justify the enforcement of law? The stability of society is here involved. Society has the right to protect itself against attack, and the greatest good to the greatest number demands that this right be exercised.

Some of us act as missionaries in elevating the aims and tastes of less fortunate men, in placing before them motives for a better life, *because*, all things considered, we prefer to do so. Many of us admire fine paintings, grand music, and generous, self-sacrificing deeds. This will ensure their perpetuation.

Those who, as a result of pre-existing causes, find themselves in the possession of a high appreciation of all that is pure and noble, will strive, more or less wisely, to surround others with influences which will draw (or push) them towards a higher life. A being sufficiently wise and powerful might at once solve our problem by at once removing all tendency to evil. Society must, however, settle the matter by a slower process—the process of education of head and heart—a process necessarily slow, and accomplished with infinite pain.

Even in so small a matter as the preparation of our food we have reached our present knowledge by painful degrees. Our rules for cooking, yet imperfect, have been reached through centuries of experiment, and at the expense of a countless number of sour stomachs and aching heads. So it has ever been in morals. Here we are all doubtless blundering experimenters, but we are gradually learning that some things are better than others, and the tendency is, slowly but irresistibly, toward a morality which is not only practiced but appreciated. In the meantime criminal law is the rude and only partially effective means for repressing those evil spirits, upon whom better influences have not chanced to act sufficiently.

If we add sulphuric acid to zinc the hydrogen does not all pass off at once; the process which follows requires *time* for its completion. So it is with the good leaven in society. The individuals are not all changed at once; those who chance to be most favorably situated are first changed. The whole process requires time, and in the meantime, urged on by our necessities, we have taken the responsibility of hanging some individuals, just as we kill obnoxious wolves and bears. So that for the present, notwithstanding all our efforts to better the condition of the poor, a large number of them will never have the opportunity to learn the instincts of gentlemen, and their senses will remain so blunted that they will not be able to realize, as we can realize, the utter wretchedness of their situation—a situation into which they are born, and from which, experience shows, the greater part of them cannot escape, even when they chance to possess the desire to escape. The misery of their condition is made yet deeper by the successful struggles of stronger and better men after *their* ideals of happiness.

It is difficult to see how an all-wise and an all-powerful Creator could have been the author of so much misery. But the other hypothesis that there has been no creation, that the universe is but the sporting-ground of irresponsible force, and that finite intelligence has been self-evolved from inanimate matter, seems equally incredible. In whatever way we view the matter this difficulty seems to me logically insurmountable, and I do not wonder that in the great poem of Milton, he describes the fallen spirits as deeply engaged in a hopeless controversy upon

> "Fixed fate, free-will foreknowledge absolute,
> And found no end, in wandering mazes lost."
>
> —Book II. (560-561.)

Happily for the business of life the irrepressible love and admiration of humanity for the pure and good saves rational men from practical error, or from rebelling against the eternal law, in which science and faith agree that although time and chance happen to all, yet that whatsoever a man soweth that shall he also reap; and in this fact that we believe that we shall be held responsible, the feeling of responsibility appears to find, at once, its explanation and its justification.

An insect which produces a species of India rubber has been recently discovered in the district of Yucatan, Central America, by an American explorer. It is called *neen*, and belongs to the Coccus family; feeds on the mango tree, and swarms in these regions. It is of considerable size, yellowish brown in color, and emits a peculiar oily odor. The body of the insect contains a large proportion of grease which is highly prized by the natives for applying to the skin, on account of its medicinal properties. When exposed to a great heat the lighter oils of the grease volatilize, leaving a tough wax, which resembles shellac, and may be used for making varnish or lacquer. When burned, this wax, it is said, produces a thick semi-fluid mass, like a solution of India rubber.

METEOROLOGY.

THE TORNADOES OF APRIL 18, 1880.

BY PROF. J. D. PARKER, KANSAS CITY.

Again the state of Missouri has been visited by a devastating tornado, which occurred April 18th, and again the phenomena and calamities of St. Charles in 1877 and Richmond in 1878 have been repeated. We observe sudden high temperature and low barometer, intense electrical activity and displays of enormous atmospheric force, with heavy loss of life and destruction of property. The aërial disturbance seems to have been very general over the western portion of the continent, from the Ohio valley to the Pacific coast and from the Lakes to the Gulf, but, so far as can be now ascertained, the most direct and well-marked line of destructive force extended from the Indian Territory, near the Arkansas River, northeastwardly, by way of Fort Smith and Fayetteville, Arkansas, Springfield, Marshfield, Russellville, Jefferson City, New Bloomfield, and Fulton, Mo., toward and to Jacksonville, Ills. Whether the other disturbances were from independent causes, or were offshoots of the same storm, is uncertain.

Besides the destruction of property and loss of hundreds of lives on this line at Marshfield, which is the county seat of Webster county, 215 miles southwest of St. Louis, on a plateau of the Ozark Mountains, though not particularly exposed by its elevation, great damage was done at Fayetteville, Arkansas, (though by an error, probably, the tornado is reported to have struck Marshfield and other points north and east of it several hours before it reached Fayetteville); also at Oak Bower, Ark., near the line between Arkansas and the Indian Territory, New Bloomfield, etc., all of which has been fully detailed by the daily papers.

On the same day, but in the morning, a fierce storm was raging in Kansas, the velocity of the wind at Lawrence reaching 80 miles an hour, the greatest ever recorded there. At Leavenworth the U. S. signal officer recorded 60 miles an hour, while at all neighboring points the fury of the storm was almost unprecedented. The barometer at the U. S. signal station at Leavenworth marked the greatest depression ever noted there, viz.: 29.04, corrected to sea level. The amount of sheet or "heat" lightning was so great in the western sky that many of the people of Leavenworth thought that Lawrence was on fire.

At this city the storm of Sunday morning was light compared with that of the evening, though throughout the whole day there was an alternation of wind, hail and rain storms, culminating in a gale at night which did some damage to roofs and fences. The maximum temperature was 82° and the minimum depression of the barometer 29.20.

It is almost impossible to indicate the paths of these storms from the data at hand, but the Signal service charts and reports, when fully made up, will doubtless give to the meteorologists some very remarkable information and suggestions.

The early appearance of tornadoes this year in this latitude seems to be exceptional. The equatorial wave of high temperature appears to have drawn them forward nearly a month. Tornadoes will occur whenever the conditions are supplied, and will of course appear earlier with premature heat.

I wish simply to call attention to the fact that the Marshfield tornado conforms as far as known to the physical laws as explained by the thermal theory. Prof. Tice, who holds to another theory, in his report of the tornado, says:

"Everywhere along the track of the tornado there is evidence of a wave of water flowing in the rear of the cloud spots. At some places there are only faint traces of such a wave; at others the debris is carried up and over obstructions of from two to three feet high. These waves or currents flowed in greatest volume up hill. There are places where the entire top soil is washed away by the currents. Fibrous roots and tufts of grass show their direction to have been up hill, and what is significant, from all points of the compass to the top of the hill where the tornado was raging at the time and expending its force. No trace can be found at any point where they flowed down hill. Many level places are swept clean of soil. Leaves, grass and debris of the wrecked buildings, fragments of plants carried along by the current and left in its track had arranged themselves longitudinally to the current."

This reported wave is evidently only the great condensation of vapor rushing from all directions into the core of the tornado.

Colonel R. T. Van Horn, in discussing the fact that tornadoes follow the isothermals, says:

"The cause is the meeting of two waves of air at different temperatures, and where should that meeting be more marked or the effects produced of as great intensity, as on the line that marks the mean between the two conditions? If there is a general law that governs in their origin and formation, there must be one that controls in their movements. And we have traced enough of them on the isothermal maps to be satisfied of the fact that their movement does correspond to these lines of mean temperature."

If tornadoes follow the lines of mean temperature must there not be some vital relation between them and heat? This is what is claimed by the thermal theory.

Electricity seems inadequate as the cause of the tornado or for the production of the fundamental movements. Why does electricity revolve the tornado north of the equator in the direction contrary to the hands of a watch, and south of the equator in an opposite direction? Why does electricity cause tornadoes to move along the lines of the isothermals northeasterly? Why do not some of them, even if only for variety, move in an opposite direction? True, light substances under a charged receiver will be attracted toward it to restore the equilibrium. But will electricity, as in a tornado in Georgia, carry up a tree, sixty feet in length and two and a half feet in diameter, half a mile high, and then fling it out of the tornado to come crashing to the earth? Why did the tree ascend in a *spiral* path? And in the Camanche tornado of 1860, why did a man, and two horses in a reversed position, sail around on the opposite sides of a circle? Can electricity under its known laws produce such results? Possibly some one may yet discover a spiral kind of electricity, and show that zigzag lightning is only the transverse section of spiral electricity blazoned on the sky.

Forests present the most efficient safeguards against tornadoes. As long as cyclones can sweep unobstructed over our prairies we shall see the sudden destruction of villages and cities and the terrible loss of life and property. But forest countries present such obstacles to the translation of tornadoes on the surface that when one touches the earth it is soon driven into the upper air where it passes off comparatively harmless. Tornadoes are one of Nature's voices telling us in unmistakable tones to plant forests. Indeed abundant forests would free us from destructive winds, drouth and locusts, our three most serious physical evils. With abundant forests, inhabited by an enlightened people observing the moral law, our prairie world would become almost a paradise.

SCIENTIFIC MISCELLANY.

A NATURALIST'S RAMBLES ABOUT KANSAS CITY.

NO. I.

WM. H. R. LYKINS.

For the lover of Nature in all her forms there are few better localities for a ramble than the hills around our city. The botanist, the entomologist and the geologist can here find much to interest them, and add many good and not a few rare specimens to their several collections. And for the fortunate possessor of a *good* microscope there is a never-ending fund of instruction and amusement in the thousand forms of fresh water infusoria inhabiting the many mossy springs oozing out on the hill-sides. The Diatomaciæ are especially abundant, encrusting the rocks with their peculiar brown hue in places where the water streams over the cliffs. As we stand upon the top of the bluff fronting westward and look down at our feet we find the rocks strewn with fossil shells; and we can easily imagine the time when this was a wave washed shore and the vast expanse spread out before us was a region of shallow seas dotted with reefs and islets; once the homes of myriads of Mollusca, from the tiny *Cythere*, no bigger than a pin's head, to the great coiled and chambered shell of the *Nautilus*, thirty inches in diameter, whose fossilized remains go to make up these rocks. In these waters also roamed a great shark, the *Petalodus destructor*, doubtless the terror of these seas, whose sharp triangular teeth we occasionally find here, being all that is left of their cartilaginous bodies.

Descending the hill, we come to the base of a cliff thirty feet in height. The rock is solid and close-grained, barren of fossils except here and there a crinoid stem or stray shell of an *Athyris*, showing that it was formed in a still, quiet sea too deep for animal life, and we pause to think how many thousands of years it took to form this one bed, if it is true, as geologists suppose, that these rocks were formed by the slow deposition of sediment washed from the ancient shores, settling down at the rate of a few inches in a century. Yet this one bed is no more in the carboniferous formation alone than a single leaf in Webster's Great Unabridged, compared with the whole volume. This cliff rests upon another bed of limestone formed under different conditions. It is an impure shaly limestone, bedded in irregular wave-like layers, showing that it was deposited in a shallow, muddy sea under the influence of a strong current. It has but few fossils except in the upper part, where there are many of the lace-like skeletons of a species of coral (*Fenestella*). And so each stratum of rock or shale tells its own history to the experienced eye of the geologist as he passes along.

Next below this is a bed of shale about fifteen feet in thickness. It is entirely destitute of fossils except a thin seam about two inches in thickness near the center, which is one mass of the stems and plates of crinoids (stone lilies) and other fossils peculiar to the carboniferous. Here, under favorable conditions, an animal life suddenly sprang into existence, grew and flourished for a while, and as suddenly perished. This place has yielded many beautiful fossils to the collector, *crinoids*, *Edmondia*, *Euomphalos*, *Hemipronites*, *Bellerophon percarinata*, &c., all in a fine state of preservation. Here was found an almost perfect specimen of the head of *Zëacrinus Mucrospinus*, a crinoid, and the only perfect one ever found anywhere, so far as we know. In a little pool of water at the bottom of this bed of shale we found our first *Rotifer Vulgaris*, or wheel animalcule, after having long sought for it in vain in other localities. Marvelous tales have been told of the tenacity of life in this little animal, especially by the Abbe Fontana, who wrote a celebrated work on the Poison of the Viper. It was claimed that it could be boiled, baked and dried for an indefinite time, and then resuscitated with a drop of water. The savants fought long and bitterly with their accustomed acrimony and tenacity over this question, and finally left off where they began, neither side being convinced. All that we ever found perished on the slide as suddenly as any of their species, when deprived of moisture. They are, however, a most beautiful and wonderful object under the microscope at all times, and well worth the trouble it sometimes takes to find them. Their brilliant and crystalline structure allows the inspection of their inner formation, and they will kindly feed on indigo, vermilion or any other coloring matter and make curious and interesting spectacles of themselves. Often they can be found in almost any puddle of water, and again we may hunt a whole season for them and not find one—at least such has been our experience.

A little farther down we come upon a clump of *Asclepia tuberosa*, their scarlet blossoms blazing like torches set upon the hill-side. The root of this plant is much sought after by old-fashioned country doctors, who consider it a "powerful remedy" for coughs, colds and diseases of the lungs. It has many common names, such as Canada root, white root, pleurisy root, &c. It is naturally an inhabitant of the prairies, but is often found growing in the woods, the only difference being in the stalks, which here rise more tall and slender owing to the more confined space in which they grow. The root is essentially the same. Many plants which grow almost exclusively on the prairies are found in the open places on the west side of these hills, such as the prairie sunflower and compass plant. The seeds, no doubt, having been brought by the prevailing west winds, lodge here and flourish, contented exiles from their native homes. There is often an interesting mixture of wild and cultivated plants, the latter being probably from stray seed from the old gardens of the early French settlers.

At the foot of a little ledge of rocks we find a pile of the dismembered limbs of the red-legged grasshopper (that bandit from Colorado, famous for its ravages in Kansas), which looks curiously like the remains of a miniature cannibal feast. We have not far to go to find the Ogre; he is at home in his cave, or crevice in the rock, a great bloated, black spider, so gorged with the juices of his victims that he can scarcely move, and we easily transfer him to a bottle and send him on a long journey to a scientific gentleman in Massachusetts. These warm, sunny slopes are favorite places for spiders, and collectors of the *arachnidae* can find many different species. There is also found here a most gorgeous beetle, whose name we do not know. It is about half an inch in length, of a slender shape, beautifully striped in green and gold, with purple legs. It is not plentiful, but can occasionally be found in bare sandy places, running about in the warm sunshine.

One of the most interesting stratum of rocks in our hills is the Oölite, a granular limestone formed of small round grains, having the appearance of petrified fish roe, and takes its name from *Oon*, a Greek word for egg. It is a fine building stone, easily dressed, and was much used in early times in our city. In places it yields beautiful fossils, especially a large *Pleurotomaria*, a coiled conical shell. Its striated surface, of a rich chestnut brown, having the appearance of being newly varnished, will vie in beauty with many a recent shell fresh from the sea-shore, and make a collector's eyes turn green with envy. The fish remains found in our rocks are principally teeth, of many species, in excellent condition. The bed, however, which has afforded the greatest variety of fossils to our collectors is found at the extreme foot of the hills. Its upper part is a layer of shale, passing into a black, flinty stone, which rests upon a fine-grained, dark gray limestone. In many places this layer of shale is one mass of fern-leaves, of several species, but principally a species of *Pecopteris*. In other places the jointed stems of an aquatic plant of the rush family, takes the place of the ferns. A curious and interesting object is the fossil shells of several species of animals, which lived on these water plants, still adhering to the stems. This bed from top to bottom is the richest field for the collector, and has furnished our cabinets with many splendid specimens of *Nautilus*, *Orthoceras*, *Goniatiles*, *Euomphalos*, *Allorisma*, *Pinna*, *Phillipsia*—in fact, nearly everything that is usually found in the Upper Carboniferous of Missouri. It is particularly rich in Nautili, and some of the cabinets in our city contain magnificent specimens of a half a dozen different varieties, some not described or figured by any of our Paleontologists. In the different collections made in this city are to be found many fossils from our hills not named or described in any of the State Reports or books on this subject, and we believe it would well repay some good Paleontologist, like the late Prof. Meek, to visit this city and examine the fossils of this locality.

We have arrived at the foot of the hill, but have glanced at only a few of the many objects of interest to be found as we strayed along. But, alas, these pleasant "rambles" are fast disappearing under the "building hand of man." Soon stately piles of brick and marble and busy streets will cover the places where we once held pleasant converse with nature, studied the pages of her book and pried into her secrets, and those who have a love for such things should improve the present opportunity to enjoy that most healthful and instructive of recreations—a ramble on the hills.

(*To be Continued.*)

THE CURIOUS INFLUENCE OF ELECTRIC LIGHT UPON VEGETATION.

At the meeting of the Royal Society last evening (March 4th) Dr. C. W. Siemens, F. R. S., gave a detailed description of some experiments upon the above subject which have been conducted during the last two months at his house at Sherwood, and exhibited specimens. The method pursued was to plant quick-growing seeds and plants, such as mustard, carrots, swedes, beans, cucumbers, and melons, in pots, and these pots were divided into four groups, one of which was kept entirely in the dark, one was exposed to the electric light only, one to the influence of daylight only, and one to daylight and electric light in succession. The electric light was applied for six hours each evening—from 5 to 11—and the plants were then left in darkness during the remainder of the night. The general result was that the plants kept entirely in the dark soon died; those exposed to electric light only or to daylight only throve about equally; and those exposed to both day and electric light throve far better than either, the specimens of mustard and of carrots exhibited to the society showing this difference in a very remarkable way.

Dr. Siemens only considers himself as yet on the threshold of the investigation, but thinks the experiments already made are sufficient to justify the following conclusions: 1. That electric light is efficacious in producing chlorophyl in the leaves of plants and in promoting growth. 2. That an electric center of light equal to 1,400 candles placed at a distance of two meters from growing plants appeared to be equal in effect to average daylight at this season of the year; but that more economical effects can be obtained by more powerful light centers. 3. That the carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc produce no sensible deleterious effects upon plants inclosed in the same space. 4. That plants do not appear to require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight and during the night to electric light. 5. That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night frost, and is likely to promote the setting and ripening of fruit in the open air. 6. That while under the influence of electric light plants can sustain increased stove heat without collapsing, a circumstance favorable to forcing by electric light. 7. That the expense of electric horticulture depends mainly upon the cost of mechanical energy, and is very moderate where natural sources of such energy, such as waterfalls, can be made available.

Before concluding his observations, Dr. Siemens placed a pot of budding tulips in the full brightness of an electric lamp in the meeting-room, and in about forty minutes the buds had expanded into full bloom.

THE SECOND HOWGATE EXPEDITION.

Captain Howgate's bill having passed the House, active preparations are being made for the start of the expedition, which is fixed for the 15th of May. The Gulnare, a steamer of about 200 tons, is lying at Alexandria, Va., being strengthened and thoroughly refitted for the voyage under the experienced direction of Captain Chester. It is expected that the vessel will be ready in a fortnight. She will start from Washington, fully manned and equipped, with two years' supplies. The members of the expedition number about twenty-five, including a corps of scientific observers. Touching at various points on the coasts of Labrador and Greenland, the expedition will proceed to the west coast of Smith's Sound at latitude 81 degrees and 40 minutes, where the first permanent depot will be made. Landing the men and supplies, the vessel will return in the fall. The general features of Captain Howgate's plan of operations are too well known to require explanation. He proposes to reach the Pole, if possible, by a system of slow but continuous advances, made during several successive seasons, pushing his camps farther and farther northward as rapidly as may be found practicable, establishing a secure basis of supplies and replacing men, who may become disabled or disheartened, with fresh recruits each year. Though this necessarily involves a large outlay of means and may perhaps cost some sacrifice of life, it will prove in the event of success the least expensive and most humane method of accomplishing the result. To lay siege to the desired goal in this systematic and persistent manner is to put a stop to the desultory and ineffectual attempts thus far made by the several nations which have so earnestly striven to carry off the prize. The Captain finds no difficulty in securing men to undertake the enterprise; his funds are ample, and he is sanguine of the success which he certainly deserves after so many years of constant effort.

The Hon. J. R. McPherson, chairman of the Senate Committee on Naval affairs and Hon. W. C. Whitthorne, chairman of the House Committee on Naval affairs are entitled to the thanks of all friends of science and exploration throughout the world for their persistent and successful advocacy of this measure.—[Ed.

WATER-SPOUTS OFF KAUAI.

On Monday, the 9th of March, there was a fine exhibition of water-spouts off the eastern coast of Kauai. When first seen just after light in the morning there were two in company. They were tall, straight and symmetrical, and as alike as two peas, extending like pillars from the ocean to the sharply-defined lower edge of a black cloud, from which was precipitated at quite a distance in the rear of the water-spouts a heavy shower of rain. To the rear again of the shower there was at frequent intervals seen the quick flash of electricity as it leaped from the cloud to the briny abyss. The whole procession was passing majestically toward the south, some ten miles out to sea, in a direction nearly parallel with the coast. One peculiarity which added to the interest of the spectacle was the slow revolution of one of the water-spouts around its mate, describing an orbit perhaps two thousand feet, or even more, in diameter. After a time the two water-spouts faded away and disappeared, and presently after a lapse of several minutes a third one was seen to be forming. The whirling base of mist on the sea and a descending cone of cloud appeared simultaneously, and soon became connected and developed into a perfect column.—*Hawaiian Gazette.*

MOSAICULTURE.

M. Chretian (writes our Lyons contemporary) has this year given us in the Parc de la Tete d'Or, some pretty examples of what he terms "mosaiculture," in the shape of beds containing mottoes and devices set out with colored foliage plants. Our Scottish neighbors seem to have carried the idea farther, with an eye to business as well as ornament. On a hillside not far from Glasgow may be read the words *Glasgow News* in gigantic letters, each forty feet long and six feet broad, formed of colored foliage plants. This inscription occupies a length of one hundred yards, and covers a space just 1,450 times the size of the Journal it advertises.—*Garden.*

OBITUARY.

SKETCH OF THE LIFE OF PROF. W. K. KEDZIE.

Prof. William K. Kedzie, who was known to many of our readers as former Professor of Chemistry at the Kansas Agricultural College, and who will be remembered by hundreds of the citizens of this city as having delivered a memorable address at the Commencement Exercises of the Kansas City College of Physicians and Surgeons in 1877, died at Lansing, Michigan, of typhoid fever, on the 14th of April. He was skilled in his profession, an excellent teacher, a ready and perspicuous writer, and a fluent and attractive public speaker. In addition to these qualifications, few men possessed finer social qualities. We condense the following items from the *Industrialist:*

He was born at Kalamazoo, Michigan, July 5th, 1851. He graduated from the Michigan State Agricultural College at the age of 19, and at once entered upon his duties as assistant to his father, the esteemed Professor of Chemistry in the same Institution. The two winters succeeding his graduation were spent at Yale College, in study, under Profs. Johnson and Brush, who testified to his great skill in manipulation and proficiency in his favorite branch—chemistry.

In the summer of 1873, Prof. Kedzie received a call to the chair of Chemistry and Physics, in the Kansas State Agricultural College. Commencing with an almost entire absence of the most ordinary essentials in imparting chemical knowledge—without a course of study, without a lecture-room, and without students even—he succeeded within three years in making chemistry the most attractive study taught in the Institution, and his department, in point of equipment and laboratory conveniences, superior to anything of the kind in the West.

In January, 1874, Professor Kedzie was elected chemist to the State Board of Agriculture, and at once he commenced and carried through a vast amount of work in the line of chemical analysis. All the principal sorts of Kansas soils, minerals, grains, and even fungi, were subjected by him to rigid chemical examination, and the results have been accounted among the most valuable in the records of our State B ard.

In the summer of 1875, the Professor spent four months in Europe, during which time he made a careful examination of the principal laboratories of the Continent and England. The ideas there obtained he was enabled, the following year, to embody in the magnificent laboratory of the Kansas Agricultural College. In July, 1876, he was united in marriage to Miss Ella Gale, of Manhattan, who is left with two small children to mourn his loss. In 1878 he received an urgent call to the chair of Chemistry and Physiology, in Oberlin, Ohio, of which his uncle was president, which he finally accepted, and entered upon the duties of his new position at the beginning of the college year. His success in that institution was fully commensurate with his ability, and the assiduity with which he pursued his studies doubtless led to the disease of whch he died.

Major Hudson, editor of the *Capital*, says of him:

No young man ever came to Kansas who made more or warmer friends than Prof. Kedzie. Old and young prized his friendship, and admired his brilliant scholarly attainments. It was our privilege to know him well and to honor his many manly traits of character. He was a pure, honorable man in his daily walk, not offensively prudish, but one of the cleanest minded men we have ever known. His idea of honor was chivalric, and his decease is a loss not only to his native state of Michigan, and to his many friends in other states, but to science.

The Lansing (Michigan) *Republican* speaks thus of him:

"During his whole life Prof. Kedzie has been an untiring worker, and although not enjoying good health, has accomplished very much. Even before he graduated, he made a fine collection of birds and birds' eggs which he donated to the college museum. He was the principal originator of the Natural History Society of the Michigan Agricultural College and has done much to make the Society prosperous."

His loss is a calamity not only to his friends, but to his *Alma Mater* and to the college with which he was connected. His chief published writings, so far as we can ascertain, were a work on the Geology of Kansas, and a number of Scientific articles contributed to the Kansas Academy of Science and preserved in its annual reports.

His character was most exemplary in every respect, and his life one to be emulated by all young men.

BOOK NOTICES.

EYESIGHT—GOOD AND BAD. By Robert Brudenell Carter, F.R.C.S. Philadelphia, 1880; Presley Blakiston; $1.50.

This is a comprehensive popular treatise on the exercise and preservation of vision, with numerous illustrations, and is well calculated to educate the public in regard to the construction of the eyes in health, their changes and defects in disease or old age, and the manner of caring for them in infancy and childhood, as well as in later life. The chapters upon Natural and Artificial Illumination and upon Practical hints on Spectacles are especially valuable to those persons who are compelled to use their eyes constantly in writing or upon fine work, and are full of useful information to all.

The author is Ophthalmic Surgeon to St. George's Hospital, London, and has had a vast field of experience in the treatment of diseased and defective eyes, and this little work bears evidence of his entire familiarity with his subject.

THE SPELL-BOUND FIDDLER. By Kristofer Janson. 12mo., pp. 161; S. C. Griggs & Co., Chicago, 1880; $1.00.

For the past year or two this enterprising firm has been publishing, principally under the editorship of Professor Rasmus B. Anderson, of the University of Wisconsin, a series of books illustrating the literature of the Norse-Land. Among these have been put forth in handsome style The Norse Mythology, The Viking Tales of the North, Echoes from Mist-Land, The Younger Edda, &c.

The Spell-Bound Fiddler is a tale by Kristofer Janson, relating in narrative form the events of the life of the wonderful musician of Norway, Torgeir Audunson, and evidently intended as an effort to break down the puritanism of the country, which fosters a prejudice against all other than church music and presents an obstacle to the progress of the Orphic art among that gifted people.

The introduction, by Prof. Anderson, contains among other interesting facts, some passages in the life of Ole Bull not hitherto published.

SEA AIR AND SEA BATHING. By John H. Packard, M. D. 12mo., pp. 121; Presley Blakiston, Phila., 1880; 50c.

With felicitous appropriateness Health Primer number XI, bearing the above title, makes its appearance, containing just the proper directions upon sea bathing, sea-side resorts, accidents in bathing, sea bathing for invalids, amusements at the sea-shore, cottage life at the sea-shore, sanitary matters, the sea-shore as a winter resort, excursions to the sea-shore, &c. With the mercury in the eighties, as during last week here, such a book will be sought for with avidity and read with profit by all who contemplate summering at the sea-side.

A SERIES OF QUESTIONS IN ENGLISH AND AMERICAN LITERATURE. By Mary F. Hendrick. 12mo., pp. 76; Davis, Bardeen & Co., Syracuse, N. Y., 1880; 35c.

The writer of this little work is Teacher of Reading and English Literature in the State Normal and Training School, Cortland, N. Y., and necessarily brings to the task a large experience. Her object is to present to her pupils the subject of literature in connection with prominent historical epochs and to suggest, by a series of questions, noted authors of each and their best known works; and the volume closes with a list of reference books and a course of reading embracing only the most prominent and standard authors.

Such a book properly studied cannot fail to be of great value to such readers.

REALITIES OF IRISH LIFE. By W. Steuart Trench. Boston, Roberts Brothers, 1880; 12mo., pp. 297; $1.00.

The object of the author seems to be to give a clear and truthful account of the occurrences which violent party spirit or local prejudices have placed before the public distorted, and also to give to the English public, in particular, some idea of the difficulties in the way of progress or improvement in Ireland, as well as to show that in spite of these difficulties such progress and improvement are really practicable. The author writes from the vantage ground of long experience among the people he describes, and his stories bear the marks of truthfulnes and candor.

Among the titles of chapters or tales may be given The Ribbon Code, The Potato Rot, The Revival, The School, The Battle of Magheracloon, &c.

TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS. Volume IV, No. 1; Octavo, pp. 190; R. P. Studley & Co., St. Louis, 1880; $2.00.

We are indebted to Professor Nipher for the above-named work, which contains two Reports by himself of his Magnetic Observations and Determinations in Missouri; a very interesting article by Judge Nathaniel Holmes, upon The Geological and Geographical Distribution of the Human Race; one by Dr. G. Seyffarth, upon Egyptian Theology, which displays a great familiarity with the language and the history of Ancient Egypt; a very practical paper upon The Improvement of Western Rivers, by C. Mc Scott; besides several others worthy of our future perusal.

This Academy is of long standing and has done much good work, especially that of Dr. Engelman and Profs. Nipher and Wadsworth in Meteorology and Physics.

OTHER PUBLICATIONS RECEIVED.

The Report of the Board of Trade of Golden, Colorado, for 1879 and 1880; Learning and Health, by Benjamin Ward Richardson; Davis, Bardeen & Co., Syracuse, N. Y., 15c; "Egyptian Antiquities" found in America, Prof. F. W. Putnam; College Libraries as Aids to Instruction, U. S. Bureau of Education, No. 1, 1880; The Effects of Civilization on the Climate and Rain Supply of Kansas, by H. R. Hilton, Topeka, Kansas; Report on the Interests and Condition of Washington University, St. Louis, Missouri, by W. G. Elliot, President, March, 1880; Report of the State Engineer of California, 1880.

EDITORIAL NOTES.

THE regular meeting of the Academy of Science was held at its rooms on Tuesday evening, April 27th. A paper upon the Theory of Probabilities, considered from a mathematical standpoint, was read by Professor J. M. Greenwood, which was followed by one from V. W. Coddington, Esq., upon the Construction of School Houses. Both papers were interesting and comprehensive, and received the close attention of the audience. They will probably appear in these columns within a short time.

ON May 21st Rev. Dr. S. S. Laws, President of the University of Missouri, and one of the best thinkers and speakers of the West, will deliver the seventh lecture of the Extra Winter Course before the Kansas City Academy of Science, upon the fruitful subject of "The Categories of Kant."

This subject was proposed by the Kant Club of this city, and all who desire to hear this difficult metaphysical topic discussed in a popular, yet comprehensive and learned manner should by all means be present. Dr. Laws possesses in an unusual degree the power of popularizing and enlivening an abstruse subject, and no one need apprehend a heavy or prosy discourse on this occasion. No charge for admittance.

MRS. MARY F. MUDGE, widow of the late esteemed Professor B. F. Mudge, offers to place at our disposal, for publication in the *Review*, portions of an unfinished work upon which he was engaged at the time of his death, several chapters of which we published last year.

Aside from the associations connected with them, these articles have the merit of accuracy, soundness, vigor and attractiveness of style, and they are in large proportion the result of personal investigation.

PROF. H. S. PRITCHETT, who furnishes an article for this number of the *Review*, has recently resigned the position of Assistant Astronomer at the U. S. Naval Observatory to take permanent charge of the Morrison Observatory at Glasgow, Missouri, in connection with his father, the well-known Professor C. W. Pritchett. Such an accession to the astronomical observers of our state tends to place it in the foreground in this branch of science at least.

A CARD.

The fourth volume of the *Kansas City Review of Science and Industry* commences with this number. My time is so fully occupied with my official duties that I find it impossible to call upon my friends in person, and take this means of asking them to patronize it.

I may say, without boasting, that the *Review* has met with a very flattering reception as the exponent of the scientific and literary culture of the West, but as it is not yet on a paying basis, I am compelled to ask additional aid in maintaining it as a home enterprise, creditable to the community and worthy of a generous support. To those who take no special interest in scientific subjects it is suggested that the articles on Domestic Economy and Hygiene alone are worth more than the subscription price, while those who desire to subscribe for any of the magazines of the country or purchase any kind of miscellaneous or scientific books, can save enough on one or two such transactions, made through my agency, to pay for the *Review* one year.

Sample copies of this number will be sent to some persons who are not subscribers, in the hope that they will become such. Any receiving it who feel that they cannot subscribe will please return it by the carrier.

THEO. S. CASE,
Editor.

Dr. G. F. Needham, Washington, D. C., sends us his Pamphlet (third edition), "Fig Culture at the North," in which he seems to show conclusively, that the people of the Middle and Northern States, by using the proper means, can grow figs of as good quality, and in abundance,at the North, as at the South, that is, as fine as the imported.

We have received of Dr. A. L. Child, of Plattsmouth, Nebraska, a copy of an elaborate report upon the Progress of the Seasons, Rainfall, Meteorology, &c., of that portion of the state, consisting of observations made and recorded by himself.

Rev. S. B. Bell, of this city, has recently commenced the publication of a religious newspaper called the *Mid-Continent Presbyterian*, into which he has introduced the novel feature of printing the communications of skeptics, infidels, and atheists, for reply. It is a liberal move and one which, if managed prudently and skillfully, will be productive of good. Dr. Bell is an earnest and zealous worker, and we wish him a full measure of success.

Captain Howgate is having built at Washington a house, with double walls, windows and roof, for the use of the men to be colonized in the Arctic Regions. It is described as "a long one-story building that looks like a large livery stable, with a shed-like addendum at each gabled end. When finished it is to be taken to pieces, conveyed aboard ship and re-constructed when the home of the polar bear is reached."

The cranium of Descartes is often adduced as an exception to the general rule that a great mind requires a large brain. This statement seems to have rested on no exact measurement, and Dr. de Bon resolved to test its accuracy. The result is that he finds the cubic capacity of Descartes' skull to be 1,700 centimeters, or 150 centimeters above the mean of Parisian skulls of the present time.

It is now ascertained that nearly two hundred years ago a Mr. Benjamin Allen discovered and reported to the Royal Society of England that eggs had been found by him in eels, a fact supposed to have been shown only within the past year.

The Quarterly Report of the Kansas State Board of Agriculture for the first quarter of 1880 is filled with the most useful statistics relative to industries, taxes, values, population, condition of crops, farm animals, meteorology, &c., and shows that in their choice of Major Hudson,as successor to Alfred Gray, for Secretary, the action of the Board was remarkably well taken.

It is impossible for us to thank each magazine and newspaper separately for kind, encouraging words spoken in regard to the *Review*, so we tender them our thanks *en masse*, and hope to reciprocate on all fitting occasions.

At the Ministers' Convention, held here last week, Rev. A. C. Williams, of Lincoln, Nebraska, read an essay entitled, Do the Revealments of Science Contradict the Revealments of the Bible? and Rev. C. C. Kimball, of this city, one upon The Influence of Modern Science upon Belief in Miracles, which latter was followed by one upon the same subject by Rev. R. M. Tunnell, of Wyandotte. These papers were ably written, and we hope to present them to our readers soon. Several other papers, more strictly clerical in their character, were read by other ministers.

The *Boston Journal of Commerce*, which is one of our best commercial exchanges, commenced its fifteenth volume in April. It is edited by Thomas Fray, Jun., under whose management it is rapidly gaining popularity as a reliable price current, an authority on mines and stocks, and a gazette of manufacturing progress and business intelligence.

PROF. C. W. PRITCHETT of the Morrsion Observatory, at Glasgow, informs us by letter, that he has completed the telegraphic connection between that institution and our Union depot, and is now in readiness to commence sending the time signals mentioned in the *Review* some months since.

THE investigation by Prof. Barker and other experts, of Edison's method of producing and maintaining the electric light at Menlo Park, does not seem to have settled the question in his favor, as, notwithstanging the favorable report, several of our best known electricians still insist that there is nothing new in his experiments, and that the electric light cannot be made practically and economically successful from his standpoint. In this connection, it is quite significant that in the competitive test in London of electric lights, the palm was awarded to the patent of Brush, of Cleveland, Ohio, and the British Government has given an order to the Cleveland Telegraph Supply Company for over $30,000 worth of apparatus, including twenty-four of the largest machines and four hnndred and twenty-four lamps.

Judge E. P. West has just returned from a trip to Marion county, Kansas, where he has been exploring some pre-historic mounds and burial places. He brings some very striking relics, and his report, which will be published in the June *Review*, will be read by archæologists with decided interest.

The *American Naturalist* says that Pierre Lorillard of New York is reported to be preparing to defray the expenses of an exploration and spoliation of the ruins of Mexico and Central America for the benefit and enrichment of some institution in Paris, under the name of the Museé Lorillard. Does not such foreign spoliation come within the purview of Monroe doctrine?

THE Vega, escorted by a large fleet of steamers, arrived at Stockholm April 25th. The city and adjacent coasts for many miles were splendidly illuminated. Prof. Nordenskjold proceeded to the Castle, where they were welcomed by the King and vociferously cheered by the people.

REV. WASHINGTON GLADDEN, who has hitherto had sole charge of the departments, Editor's Table and Literature, in *Good Company*, has relinquished his connection with the magazine, all of which will now be under the supervision of Edward F. Merriam, who has had exclusive management of the Contributor's department. This arrangement begins with Number Eight.

SPECIAL NOTICE.

KANSAS CITY

Review of Science and Industry,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. JUNE, 1880. NO. 2.

ASTRONOMY.

THE SUN AND PHENOMENA OF ITS SURFACE.

BY WM. DAWSON, SPICELAND, IND.

I have no doubt that the sun contributes much more to all the comforts and happiness that we enjoy in life than people generally think. It is very large and very distant. Our earth is a great body, and to travel round it—25,000 miles—is a long journey. And yet this, more than three times 8,000 miles, is only one-ninth of the distance to the moon. Now if the sun were a hollow sphere and the earth placed in its center, the moon might be at its present distance from the earth and still be but slightly more than half way from the sun's center to its surface.

The diameter of this vast source of light and heat is given at 860,000 miles, and its distance at about 92,000,000.

Presuming that readers of the Review already have a general knowledge of the spots on the sun, from an article on this subject in the Number for May, 1879, I will now briefly recite the more important solar phenomena as presented in my six-feet telescope during last year; and then allude to the causes of sun spots, and other matters with which they are supposed to be connected.

During 1879, I observed the sun about every clear day the year through; generally using a magnifying power of 100, furnished with a reflecting prism which admits the full aperture of the object-glass, $4\frac{6}{10}$ inches. This arrangement gives a more interesting view of the varied phenomena of the solar surface than the direct view with a common eye-piece, which requires a cap or diaphragm over the object-glass to prevent too much light and heat entering through the objective. The reflecting prism is a piece of glass of such form as to allow a great portion of the sun's light to pass entirely through and out of the telescope, and still reflect enough to form a good image, and give a fine view of the solar surface. Examined in this way when the air is very clear and calm, (which, though, is rather seldom, even when no clouds are visible,) the disk presents a delicate mottled or granular appearance as though there existed many thousands of fine freckles all over the fair face of the sun. Sometimes, indeed, it seems rather difficult to distinguish between the largest of these minute forms and the least of the solar spots. Besides these freckles I sometimes notice a very white curdled or brain-like appearance—possibly masses of "rice grains," etc.—to be described further on.

In January two spots were observed in the fore part of the month; and I saw only two others—on the 30th; from which we may infer that the sun was nearly clear of spots all the month. I saw none in February till the 14th, when a small group appeared, and vanished in a few days. Except a small spot March 14th, no more were seen till the 11th of April, when a group of five little spots and bright faculæ appeared at the eastern edge of the sun. Next day the group contained sixteen spots. On the 13th nine. In one part of the group, several little spots had united into one, which was surrounded by bright penumbra. By the 16th a group of twenty-five spots had formed, seven of which were large. On 20th they were mostly gone—only one remaining. It was near 5,000 miles in diameter, and could be seen with a small spy-glass. It grew smaller, and disappeared at the western edge of the sun on the 23d. On 24th no spots, but the mottled appearance was very prominent—like innnmerable little specks over the sun's face. No more spots this month. May 6th, bright facula at east edge. Next day a group of spots appeared there. On 8th and 9th, about a dozen were seen—one of them pretty large. By 13th the group had dwindled to one little spot. No more till June 4th, and very few till 27th, when a group of fourteen spots was visible, and in three days it numbered thirty-seven. It fell off to one by July 5th. In six days a group of twenty had formed. On 13th one of them was near 8,000 miles in diameter—nearly large enough to be seen without a telescope. It was surrounded with a wide penumbra. On 14th the sky was uncommonly clear and fine, and the general surface of the sun appeared of a whitish, curdled, or brain-like appearance. By 18th the cluster had vanished.

It may be noted that the ordinary black spots never, or but very seldom, appear near the *poles* of the sun; but now one or two *white* spots were visible in the region of the north pole. On 26th the mottled and fine brain-like appearance were very prominent. August 9th, several white spots were seen at intervals *all round* the sun's margin.

It will be understood that these white spots are entirely different from the common sun spots, which are always black or nearly so. Quite a showing of solar spots occurred on the 8th to 14th of August. On 12th a large group broke out near the west edge and soon disappeared. Another spot show occurred in the last of August. Between 8 o'clock of 28th and the same hour of 29th, a very large spot broke up and formed three smaller ones. In three or four days after this wreck in the sun, a great rain fell in our country. Very few spots in September. But a large cluster was very prominent from October 7th to 11th. In a few days other spots broke out in different places, making a speckled appearance on the sun's face. About the 21st they had all disappeared, leaving the sun clear for two weeks, and nearly so for three weeks. Toward the middle of November a large group formed and passed over the western side of the sun. A few small spots on several days in December closed the exhibition for 1879. A show of fifty-five spots in three groups occurred in the middle of January, 1880; and since that time but few days have passed without spots being present on the sun. So it is evident that they are now on the increase. And I am not sure but that it is more rapid than it was in the early part of the period which commenced in 1867. I consider that the minimum this time occurred in the early part of 1879; making the period twelve years long.

About eleven years is the average length of several former periods from one minimum to the next. The extremes are about ten and thirteen years.

Greater activity seems to prevail during the first half of the period than during the last half, so that the maximum, or greatest show of spots, occurs about two years before the middle of the period. But I am satisfied from my own observations that the maximum of the last period was near three years before the middle, particularly as regards the number. However, spots of large size continued two or three years after their number began to grow less.

In attempting to explain the freckly or mottled appearance, I would offer the one theory of its being the interstices of the darker or gray portion of the sun's surface in which a very large telescope, furnished with a polarizing eye-piece, shows "hundreds of thousands of small intensely brilliant bodies, that seem to be floating in the gray medium, which, though itself no doubt very bright, appears dark by comparison. What these little things are, is still uncertain; whatever they are, they are the immediate principal source of the sun's light and heat." They bear a certain resemblance to rice grains of different size and shape. Although these little bodies appear quite small when they are magnified even many hundred times, yet they are really hundreds of miles in extent. It is believed that these little fiery bodies collect in dense masses and form the cloud-like faculæ which often appear near the edge of the sun, and are apt to precede the formation of large spots, though not in every case. These faculæ are often so large and prominent as to be visible through a telescope of 1½ or 2 inches aperture. Huyghens said of them near two centuries ago, that they seem to be "something in the sun brighter than the sun itself."

It is now a settled belief among those who have given the subject most attention, that iron, magnesium, and other metals exist in the sun, and particularly in the region of the spots; though not in the solid state in which we know them, nor even in the melted or liquid condition, but in the form of gas, or vapor—

the result of most intense heat. Great masses, or clouds of vapor charged with these gases exhibit the most fitful and ever-changing forms which it is possible for us to conceive. Realize if you can, the effects of one of our most violent hurricane storms in which the wind travels two or two-and-a-half miles in a minute, and smashes the largest buildings and trees it meets. Then picture in the mind a raging storm as much more violent than the hurricane as the hurricane exceeds a gentle breeze, and you may approach a faint idea of the wonderful commotion that sometimes pervades the surface of the sun.

When a mountain mass many hundred miles in extent, or a vast whirlpool of equal area, is actually seen to form and then scatter and disappear in less than one hour, we have strong proof of the great activity just alluded to. Mountain forms of burning hydrogen make up the rose colored prominences which nearly always exist along the edges of the sun. Before the invention of the spectroscope, these "red flames" were seen only during total eclipses of the sun. But now, this wonderful instrument shows them *any time* when they are large enough to be seen.

A solar outburst of much interest was observed by Prof. C. A. Young, of Dartmouth College, in 1871, September 7th. On that occasion he saw what seemed to be tongues or filaments of burning hydrogen shoot up from a great prominence whose height was already 100,000 miles, to an elevation of 200,000 miles—having made the hundred thousand miles in ten minutes—denoting a velocity of 167 miles per second.

I understand the Professor, as well as R. A. Proctor, of England, to entertain the idea that the internal forces of the sun are sufficient to, and possibly do, eject solid matter from the sun's interior never to return; and that "it is by no means impossible that some of the specimens of meteoric iron in our cabinets are really pieces of the sun." Whether or not this theory is tenable, there is no want of evidence that most astonishing forces do exist in the sun.

The general theory of sun spots, as I understand it, is, that amid the mighty rush of torrent vapors great rents or openings are made in the photosphere (outer visible surface of the sun) extending deep in the sun's interior; and that a spot is simply a black and vacant space—the "central darkness" of a solar whirlpool. In regard to the cause of solar spots, etc., I wish to introduce another paragraph from C. A. Young: "What are the causes of such eruptions it is impossible to state as yet with any certainty; still, knowing what we do of the enormous amount of energy which the sun is continually pouring out in the form of heat, it is nothing strange that such things should occur, and that on a solar scale."

A feature of much interest in connection with sun spot periods is their correspondence with similar periods of Aurora Borealis, and magnetic force of the earth; the greatest prevalence or maximum of each one accompanying that of the other. A noticeable instance of this occurred in 1859, September 1st. Two observers in England were examining a large group of sun spots at the same time, when they noticed an amazing outbreak of "two patches of intensely bright white light in front of the spots." These dazzling patches continued visible near five minutes, during which time they passed over a space of 33,000 miles. At the same moment (as was afterward learned) a noted disturbance occurred among the magnetic instruments at the Kew Observatory; and in sixteen hours a magnetic storm set in, which not only impeded communication by telegraph, but set fire to some of the offices. I well remember seeing brilliant Auroras on several nights at and near that time.

The following points, I think, are less entitled to acceptance than the one just mentioned. The theory that Jupiter and Venus exert an influence in the production of sun spots and their periodical occurrence, seems to me very much like that of the moon exerting an influence on the weather, the growth of vegetables, etc.,—one in which I have but little confidence. Looking at the very face of the matter it seems much more probable to me that the gigantic powers of the sun would produce the comparatively feeble magnetic and electric phenomena of the earth, than that Venus and Jupiter in any position they can have, would produce the raging forces in the sun, or even change their directions. A. Elvins, an observer of Canada, gives the opinion that years of sun spot maxima and minima are generally more cloudy than the intervening years. My own observations hardly confirm this view. So with his conclusion that greatest and least show of sun spots have less rain and more cold than other years. Mr. Elvins, with one or two other investigators of these subjects, decide that cylones and heavy storms generally occur in about two years after a sun spot maximum. This is doubtless correct. But our cylones occur so frequently in other years, and even during sun spot minima, that I fail to see the foundation of a law in *this* point. But their idea that both the maxima and minima of spot frequency are immediately preceded by *very wet* years, or season, I find to be true in most cases that I have examined.

And yet, as regards nearly all the above subjects, I heartily endorse the following sentiment put forth by Arago: "In these matters we must be careful not to generalize till we have amassed a large number of observations."

The sun is a great body, and I am sure that the hidden source of its wonderful energies is the Almighty Hand which created and governs the whole universe.

THE GREAT SOUTHERN COMET.

The interest of the astronomical world was suddenly awakened early in February by a telegram from Dr. B. A. Gould, at Cordoba, to Prof. Peters, of Kiel, stating simply that there was a great comet passing the sun northward. This, together with the announcement of Dr. Gill, of Cape Town, a few days later, which, from the lack of unity in the system of signalling astronomical discoveries, could not be determined to be the same one, caused an amount of excitement among amateur astronomers that is quite unusual. Sufficient facts have not been as yet determined to render a thorough discussion of the comet possible, but nevertheless it is none too early to begin the accumulation of such facts, as this may at a later time be a much more serious undertaking. The story of the discovery of Comet I. 1880, is given in an extract from a letter from Dr. Gould to Prof. Peters, which is in the *Astronomische Nachrichten*, No. 2303.

On the evening of February 2, Dr. Gould saw, during twilight, a bright streak of light in the southwest, which he immediately supposed to be the tail of a huge comet. An attempt to sketch the object was made, but, owing to the murkiness of the sky, it was unsuccessful. The approximate position of this streak of light was from R. A. 22h. 40m.— 45° to less than R. A. 23h. 0m.— 50°. On the 3d of February, the object appeared somewhat brighter, and had moved northwards throughout its entire length, and was evidently the tail of a comet which seemed to be approaching perihelion. All attempts to detect a nucleus were unavailing, and the equality in the brightness of the tail throughout its visible length of fully 40° and the remarkably small decrease of its breadth toward the horizon prevented any safe conjecture as to the position of the nucleus. On the 4th, the comet seemed to be a little brighter, and the tail preserved the same peculiarities as before, and in brilliancy was in no part equal to the milky way. This evening, Dr. Gould observed what he considered to be the head of the comet, which through the haze and twilight appeared to be a coarse, ill-defined mass of dull light, some 2′ or 3′ in diameter and without any visible nucleus.

Observations made by Mr. Gill, at the same time, are noted in the *Observatory* for March, although not fully. Among the early newspaper items may be quoted that of Prof. Peirce, who lost no time in comparing the data of Gould's comet with those of the comet of 1843, and announced himself as fully persuaded that it was a return of the earlier comet.

Quite early in the field was the Observatory of Rio Janeiro, the Director of which, Prof. Liais, in the *Astronomische Nachrichten*, No. 2304, under the date of February 20, makes a report of the same. At Rio, the weather was unfavorable, and, save the 4th and 8th of February, the comet was not observed. In other parts of the Empire, however, observations had been made sufficiently numerous to justify the statement of an approximate orbit, which, in view of later data, it is not necessary to give in detail.

According to *Nature*, No. 540, Mr. Gill saw the tail of the comet even as early as February 1. No. 541 of the same periodical contains an extract from a letter by Mr. Gill, specifying his observations up to the 9th of February. As Table Mountain interfered with the view of the comet from the Royal Observatory at Cape Town, Mr. Gill went over to Seapoint, on the west side of the mountain, and sketched the position of the tail, on several evenings. The next issue of *Nature* contains elements of the comet, by Mr. Gill, which, however, may be considered as in error, in consideration of the elements given in No. 544 of the same periodical. These elements were computed by Mr. Hind from the observation of Dr. Gould on February 4, and from rough places communicated by Mr. Gill. These elements are as follows:—

COMET I. 1880. GOULD.

Perihelion Passage, January 27. 6027.

G. M. T.

Long. Perihelion, ...	279°	6′.8.
Long. Node	4°	1′.9.
Inclination	35°	39′.8.
Per. Distance	0.0059390.	
Motion, Retrograde.		

According to the same periodical, the comet was observed from H. M. S. "Triumph," while at sea, between Payta, in Peru, and Manta, in Equador, on the night of February 7. The nucleus was seen at this date, and the comet was again observed on the 8th and 9th.

According to the *Observatory* for April, the comet was so faint on the 23d of February that Mr. Gill conld not discern the least trace of it, there being strong moonlight, however.

As has been stated, Prof. Peirce was very early in the field with an assertion that this comet was a return of that of 1843. and in this his judgment has not been at fault, for, taking either the elements of Mr. Hind or those which may be considered as the next most authoritative, the resemblance is altogether too close to be the result of accident. The elements of the comet of 1843, as computed by Hubbard, were —

Long. Perihelion	278°	35′.1
Long. Node	1°	20′.6
Inclination	35°	38′.2
Per. Distance	0.005511.	
Motion, Retrograde.		

In view of thc relationship, a few notes on this great comet—which, says Cooper, in his Cometic Orbits, has been considered the most interesting of any on record—may be acceptable.

Prof. Peirce, in the note to the *Boston Advertiser*, already referred to, gave as his opinion that Dr. Gould's comet is that of 1843, and has been seen before in B. C. 1770, 370, 252, 183, and A. D. 336, 422, 533, 582, 708, 729, 882, 1077, 1106, 1208, 1313, 1362, 1382, 1402, 1454, 1491, 1511, 1528, 1668, 1689, and 1702.

"In 1843," says Prof. Peirce, in a lecture on comets and meteors, "at about noon on the 28th of February, people in New England were able to see a brilliant object close to the sun. Such a marvelous spectacle had never before been seen. Accurate and reliable observations of its position with regard to the same were made. A week later, a wonderfully brilliant tail of a comet was seen skirting the horizon just after sunset, reaching one-third of the way around. At perihelion, it was nearer to the surface of the sun than any known comet, save that of 1680, and both of them swept in nearer than the solar corona."

It was estimated by Newton that the comet of 1680 was subjected at perihelion to a heat equal to 2,000 times that of red-hot iron.

The discussion of this comet made by Prof. J. S. Hubbard, and published in Dr. Gould's *Astronomical Journal*, Vol. i., is pre-eminently the authority concerning it. Much difficulty was encountered in an attempt to fix its orbits, owing to the shortness of time for observation, proximity to the horizon, and the slowness of its motion. The peculiarity producing the most remark was the smallness of its perihelion distance, resembling the comet of 1680, while its physical characteristics resembled the comet of 1668. In concluding his discussion (Vol. ii.), Prof. Hubbard states as follows:—"So far as the data employed and the calculations based upon them can be relied upon, the hypothesis of the identity of this comet with that of 1688 is not sustained." The probable error of a single observation of his computed orbit was determined by Hubbard to be $= \pm 10''.62$, and considering also the probable error belonging to an orbit of 175 years, the difficulty stated by Nicholai shows itself, viz.: that "the transition from a period of 175 years to one of infinity, makes almost no difference in the representation of observations." So small a portion of the orbit is it within our power to observe, that the differences in the observations upon a long orbit and those on an infinite curve are extremely difficult of determination. In the consideration of the comet of 1880 and its discussion, the observations made in 1843 may be of the gr eat e importance.—*Science Observer.*

CORRESPONDENCE.

SCIENCE LETTER FROM FRANCE.

ATMOSPHERIC DUST—KLEPTOMANIA—HUMAN HEAT—PHOSPHORESCENCE.

PARIS, April 13, 1880.

The Scientific Association of France has resumed its instructive Saturday Evening Conferences at the Sorbonne, our Royal Institution, under the presidency of the celebrated and indefatigable M. Milne Edwards. The subjects selected are of every day, living interest, are the specialty of each lecturer, and are handled in a popular manner and illustrated with every suitable apparatus. M. Jamin has expounded the latest discoveries in telephones and phonographs; M. Egger has deciphered the recent papyrus finds in Memphis; M. Bouley has examined the question of rabies, and M. Gaston Tissandier, of elevated ballooning notoriety, has revealed many interesting facts on atmospheric dust, its connection with cosmical matter, and the important rôle it plays in fermentation and decomposition. As the air is purer after being washed by rain, so in dry weather and especially in cities, the atmosphere is a veritable dust-bin; we are sensible to the existence of these particles of attenuated matter; in breathing them they disgust us, and in falling and remaining on clothing and furniture they demonstrate not only their presence but their plenitude. Admit a sunbeam into a darkened room and the molecules will be revealed like nebulæ; yet the numbers we perceive, are perhaps but the minimum of what exists, for after the naked eye and the microscope there are minutiæ which dance still. Much of this atomic debris is of inorganic origin, and a great deal is derived from animal and vegetable sources; the renowned experiments of M. Pasteur have demonstrated, that among these atomies which live, move, and have their being in the air, are germs or spores of fermentation and decomposition, that is to say, the seeds of disease and death. Showers of dust impalpable as flour, and sometimes red as blood, have fallen in several parts of the world, astonishing or frightening, as the populations are superstitious or cultivated; these showers are simply silicious particles whipped up to the superior regions of the atmosphere, and driven along by aerial currents; such particles have been lifted in Guiana and showered on New York, the Azores and France, as Ehrenberg detected therein animalculæ and shells, peculiar to South America. Over the summits of the high mountains of the latter country, the atmospheric currents are ever charged with silicious powder, and in parts of Mexico, the crests of mountains act as veritable bars, and compel the deposition from these air streams of the dust, and which accumulate in the valleys to the depth of ninety yards. Geology recognizes these atmospheric deltas. The foam of waves as they dash against the coast, is pulverized into feathery pellicles, which float sky-ward with a trace of saline matter and that a sea breeze carries far inland. Space contributes as well as earth and ocean to the production of aerial dust; when meteorites and falling stars are rendered luminous and incandescent by their rubbing against strata of air in their vertiginous flight, they part with quantities of their metallic elements in the form of powder, iron, nickel, and cobalt, substances that Nordenskïold has gathered on the virgin snow of the Polar regions. When atmospheric dust, whether collected directly on a sheet of paper, or from the sediment of snow and rain, is probed by a magnet, the tiny particles of iron attracted, have all a spheroid family likeness, resembling furthermore iron filings if melted in a flame of hydrogen or the extinguished sparks that fall on striking an ordinary flint and steel. Nay more, similar atoms of meteoric iron have been traced in the Lower Lias formation, geology thus affording evidence, that as now, so before the appearance of man on earth, atmospheric dust existed. The air is a vast store house of animalcules; expose a solution of some organic substance to the atmosphere for twenty-four hours, it will be speedily inhabited by myriads of infusoria, rolling and tumbling, yet so small that hundreds of them if placed in a row would not form a line in length. These worms resemble little eels Analogous animalcules induce decomposition and fermentation, for the latter cannot take place unless the organic matters be in contact with the air, to receive the seed of the leaven, which by cellule propagation leavens the whole mass. It has lately been shown that the process of nitrification in certain soils is due to a peculiar ferment, that is to say, to a spore floating in the atmosphere, and finding its conditions for action, stops and operates. Marsh fever is due to cellules or spores existing in a bog neighborhood; the same spores have been detected by the microscope in the expectorations of the patient, in the dew that was examined, and on the surface of the peaty soil where they were generated. This is simply poisoning; to a like cause is due the fell disease known as hospital gangrene, the germs in the polluted ward-atmosphere, enter the wounds, induce putrifaction, and death. Hence the importance of washing the affected part with carbolic acid or other anti-septic; then dressing it with a wadding that will intercept, by acting as a filter, the germs to be deposited, from being sown. In many factories workmen become victims to the dust, generated by their special industry, entering and saturating the lungs; on dissecting old colliers, their lungs after forty years respiration of dust, instead of being rose-colored as in health, were as black as the coal itself; the dust in this impalpable form is often the cause of accidents; it can take fire and blaze like alcohol. Witness the catastrophe at the Minneapolis flouring mills; the confined air highly charged with the flour, became on a par with ether or alcohol, awaiting only ignition from the heated millstone to burst into flame and explode.

The Society of Legal Medicine has discussed the question of shop lifting; no very clear results have been arrived at; it was maintained that in the case where the accused female's family was liable to hereditary cerebral irregularities, the court ought to accept such as an extenuating circumstance. It seemed to be the opinion, that too much importance was attached to the abnormal inclinations and fancies of women *enceinte*, and also, that the interests of justice were not served by the numerous classifications that alienists indulge in. Dr. Lasségue repudiates all the doctrines about monomanias; a woman shop-lifts because she has not the strength to resist, and if any obstacle rises up to baulk her thieving, that chance will save her, as reason does in the case of others. He disbelieves in the theory of excitement; the seduction is not greater than what other females experience at the view of articles of toilet; it is transitory, and the thief speedily forgets not only the pleasure she anticipated from possessing an object easily obtained, but the fault itself. He concludes, the less the impulsion of the weak-minded will be imperious, the more she will be encouraged by every attraction—that of impunity included.

M. Hirn has devoted a good deal of attention to the subject of human heat, and in his experiments has been assisted by Professor Herzen, of Florence. Heat, or caloric, is synonymous with force, and there ought to be a gain or loss of heat, following the nature of the work. For example: the exertion to raise our own weight in ascending a stair-case, or a mountain, must represent a loss as compared with descending either. Now, M. Herzen affirms in both cases the contraction of the muscle is almost the same; there is only a slight difference in the intensity of the contraction executed, but none in point of view physiological. From the moment there is no external work, there is no consumption of heat; when a muscle contracts, there is a diminution of temperature, and deoxidation. Following the contraction or expansion of the muscles, the physiological actions will vary: a Swiss guide will ascend a mountain, carrying a burden, without manifesting fatigue; but perspiration will be more or less intense; the pulse and respiration will be accelerated; the panting will be more or less sensible, following the robustness of the individual. These phenomena will be less during the descent. Does intellectual work consume or produce heat? No, according to M. Hirn, the course of our thoughts modify at each moment the march of the organic functions; each feeling of joy, of sadness, of pain, of fear, or of agony, determines special modifications in the rythms of the pulse, of respiration, etc.; nervous persons know how each emotion may create muscular tremblings, and active heart-beatings; intense and sustained intellectual work often produces cutaneous transpiration, amounting to positive perspiration. Is there no loss of heat in this case? None, because the labor is internal, and has nothing in common with external manual work; but the intellectual exertion can influence the nature of the materials that oxygen burns, during the process of respiration; it can modify the employment of oxygen, and thus change the conditions of combustion.

M. de Bellesme has been studying the phosphoresence of the glow-worm, from the physiological side; he substituted for the will of the insect, an electric current, and was thus enabled to produce the luminousness desired. He ascertained, and so corroborates Matteucci, that the presence of oxygen is indispensable to the production of phosphoresence, hence, there is in the luminous organ the production of a matter, which, in combination with the oxygen of the air, produces light; the structure of that organ excludes the possibility of all secretion, liquid or solid, for the matter is gaseous, and only phosphuretted hydrogen is glowing under ordinary conditions. Not only is there no phosphorus accumulated in the organ, but there is no provision of matter at all. M. de Bellesme has demonstrated conclusively, that the luminous substance is produced in proportion as it is required—never accumulated; that phosphorescence is a general property of the protoplasma, the result of phosphuretted hydrogen produced therein by chemical decompositions in connection with the cellules of the organ; the decomposition in the case of the glow-worm, being under the nervous influence of the insect, and which is essential for setting free the phosphorescence.

The estimation of the quantity of cream contained in milk can now be made very accurately and rapidly, by means of centrifugal force. Attach the handle of a can, filled with milk, to a cord; hold the other extremity of the latter in the hand, and twirl as if for a sling; the cream, lighter than the rest of the milk, will accumulate on the surface free from all liquid, and more quickly than if in a state of repose; the time will even be lessened in proportion as the revolutions are rapid. When the milk has a temperature of 59 to 68 degrees F., the separation of the cream takes place in fifteen minutes, at the rate of 600 revolutions per minute. At the same time the quantity of water added to the milk for adulterating purposes can be ascertained. M. Gembloux having tested that pure milk contains 10 per cent. of cream, added one, then a second tenth, of water, and when whisked, the cream represented but nine and eight per cent. of the volume of milk. Further, when whirled in the cylindrical churn, the contents formed three distinct layers—cream, water, and skim-milk. The same centrifugal test was applied to butter, maintained in the liquid state by means of hot water; the matter separated into three states toward the circumference of the churn—fatty butter, caseine, and salt water; it was in the latter all the mineral adulterations lodged. It was at the Exhibition of Vienna that an apparatus for separating cream from milk by centrifugal action, was first made known: it is to M. Lefeldt that the honor reverts for applying the system on a vast scale by means of a turbine cylinder making 800 rotations per minute, when the cream is formed round the axle of the machine, after which comes the skim-milk, and then the impurities, forming, as it were, three rings or zones. Other skim-milk is introduced, which forces up the cream to run over, and thus out of, the cylinder. M. Lawal's Swedish skimmer is so constructed, that in proportion as the cream and skim-milk are separated, they pass off by the entrance of fresh milk. In the co-operative dairy at Kiel, 4,000 quarts of milk the produce of 550 cows, are centrifugally skimmed per day.

M. Forel's experiments on Swiss Lakes prove that cold can penetrate therein to the depth of 120 yards.

M. Nordenskjold has stated, in a letter to M. Daubrée, that judging from his dredgings in the Siberian Sea, the fauna most rich in individuals, at a depth of from 33 to 110 yards, does not exist between the tropics, but in the Glacial Ocean and the Behring Sea, where the temperature, too, remains at the bottom, from 30 to 28 degrees F. The municipality of Paris intends receiving and honoring M. Nordenskjold in the name of French Science. F. C.

PSYCHOLOGY.

THE SOUL—WHAT IS IT?

Concerning the constitution of man there are three distinct theories. The first regards him as composed simply of a body, actuated for a time either by the ordinary forms of energy or by some modification thereof not yet recognized, and as losing at death his personal individuality. The second and more popular view acknowledges in him a double nature, comprising, in addition to the palpable, ponderable, and visible part or body, an invisible and immaterial principle, known promiscuously as "soul" or "spirit." But there is yet a third theory, which considers man as a threefold being, made up of body, soul, and spirit. It is no part of our present purpose to define the exact sense in which these last two terms are used. It may suffice to say that by the ordinary advocates of the triplicity of human nature the "soul" is supposed to be the purely immaterial element, whilst the "spirit" forms a connecting link between the two, and, if not purely incorporeal, possesses none of the ordinarily recognized properties of matter.

An author* whose speculations we are about to examine, exactly reverses these two terms, and looks upon spirit as a something absolutely immaterial and transcendent, whilst the soul, the seat of the will, the passions and emotions, is perceptible by one, at least, of our senses, and is even capable of being experimentally isolated and obtained in solution.

We find ourselves confronted by a number of facts, hitherto without explanation and without connection. Among these must rank the phenomena of sympathy and antipathy as between different individuals, human or brute. On first meeting with some person of whom we have no previous knowledge, we often experience a strong liking or a violent dislike, for neither of which we can render any definite reason. As a rule women and children are more frequently impressed in this manner than are adult men. It very often happens, too, that if we suppress and overcome these sudden prepossessions, we find in the end that they were justifiable, and that second thoughts were not best.

Further, the emotions and passions of men assembled together are infectious, passing from one to another more rapidly than bodily diseases. From one or from a few energetic individuals enthusiasm may be diffused through a senate, a regiment, or a ship's crew. On the other hand, a few terrified or bewildered persons may spread a panic among thousands. It is commonly said that emotions propagate themselves, but we wish to know in what manner and by what means this is effected. * * * * * * * * * *

We find, again, sympathies, and especially antipathies, which may be traced between entire species of animals, and which some of us seek to explain by the indefinite and long-suffering word "instinctive." If a dog has been stroked with a gloved hand, and if the glove is then held to the nose of a young kitten, still blind, the little creature begins to spit in anger. How is this fact to be explained? The kitten has never yet seen a dog, but in the mere odor it recognizes a hostile element. Heredity? True, but how is the antipathy handed down from generation to generation? By what sign does the blind animal detect the presence of an enemy?

There is still a further phenomenon which may be looked on as a heightened antipathy—fascination. We all know that very intense fear, instead of prompting to flight, may paralyse. * * * * * * *

Taking a general view of all these phenomena, in so far as they are actually established, it would seem that animals, including man, must throw off from their surfaces some emanation capable of acting upon other animals and men with whom they come in contact or in near proximity. This supposed emanation may vary

*Professor Jager.

in its character in one and the same individual, according to its psychical condition. If the vapors or gases thus emitted by two animated beings are in harmony, the result is sympathy or attraction. If they disagree, the consequence is antipathy, showing itself as hatred in the strong and as fear in the weak. This, it will be doubtless admitted, is a possible explanation of some of the phenomena above noticed; but is it the true or the only one? Do such emanations really exist? It is, we think, certain that many animals become aware of the presence either of their prey, of an enemy, or of a friend, by the sense of smell, even at very considerable distances. Our lamented friend Thomas Belt was led to the conclusion that ants are able to communicate with each other by means of this sense, and have in fact a smell-language. Unfortunately the sense of smell is so weak in man that it becomes very difficult for us to decide.

Prof. Jäger holds that certain decompositions take place in the animal system in strict accord with psychic changes. All observers, he tells us, agree that muscular exertion effects but a very trifling increase of the nitrogenous compounds present in the urine. On the other hand, Dr. Boecker and Dr. Benecke* have proved that intense pleasurable excitement effects a very notable increase of the nitrogenous products in the urine, derived, as a matter of course, from the decomposition of the albuminoid matter in the system. Prout and Haughton have made a similar observation concerning the effects of alarm and anxiety. Hence, therefore, it would appear that strong emotion involves an extensive decomposition of nitrogenous matter, and in particular of its least stable portion, the albuminous compounds. But does the whole of the matter thus split up reappear in the urine? Prof. Jäger thinks that a portion escapes in a volatile state, forming the odorous emanations above mentioned. *This portion he considers is the soul*, which exists in a state of combination in the molecule of the albumen, and is liberated under the influence of psychic activity. Hence his soul, like the body, is not a unitary entity, called once for all into existence, but is a something perpetually secreted, and as perpetually given off. It pervades the entire system. Each organ has its distinct psychogen, all of which, however, are merely differentiations of the one primary ovum-psychogen. Further modifications take place from time to time, in accordance with the mental condition of the man or other animal. It will here be remembered that, according to Haeckel ("Die Heutige Entwickelungslehre in Verhältnis zur Gesammt-wissenschaft"), all organic matter, if not matter altogether, is be-souled. Even the "plastidules"—the molecules of protoplasm—possess souls.

In support of the assumption that a volatile something is given off from albumen, Prof. Jäger gives the following delicate experiment:—If we prepare, from the blood or the flesh of any animal, albumen as pure as possible, and free from smell and taste, and treat it with an acid, there appears a volatile matter which is perfectly specific, differing in the case of each animal species. But this odor varies according to the intensity of the chemical action. If this is slight we perceive the specific "bouillon odor" which the flesh of the animal in question gives

*Pathologie des Stoffwechsels.

off on boiling. On the contrary, if the reaction is violent, the odor given off is that of the excrement of the species. Here, then, we have the two main modifications of psychogen, the sympathetic and the antipathetic form.

Dr. O. Schmidt, Professor of Chemistry and Physics at the Veterinary College of Stuttgart, has repeated these experiments upon the brains of animals. The odoriferous principle is here evolved much more easily than from egg albumen. Immediately on the addition of an acid an offensive odor appears, which vanishes as rapidly, and cannot be caused to reappear. Nor has it been found possible to elicit from brain the more agreeable odor.

It will doubtless be granted that certain yet unexamined specific odors are given off by living animals; that these odors may be repulsive or attractive to other species; that they may be liberated more abundantly under mental excitement. But where is the proof that these odors are the soul in any condition? May they not be regarded merely as an effect which psychic emotion, along with other agencies, produces in and upon the body?

We will, therefore, though not without misgivings, quote an experiment to which Duntsmaier attaches much importance. He placed in a large wire-work cage a number of hares, and allowed a dog to run around this prison, snuffing at the inmates, and attempting to get at them for about two hours. It need scarcely be said that the hares were in a state of great terror. At the end of that time the dog was killed; his olfactory nerves and the interior membranes of the nose were taken out with the least possible loss of time, and ground up in glycerin. The clear liquid thus obtained contained the souls of the hares, or at least portions of them, in an intense state of painful excitement. Every animal to whom it was administered, either by the mouth, or by injection under the skin, seemed to lose all courage. A cat after taking a dose did not venture to spring upon some mice. A mastiff similarly treated slunk away from the cat. Now we are here confronted by a serious difficulty: if a second dog was rendered timid by merely a small portion of this extract of fear, how is it that the first dog, after snuffing up the whole, did not suffer the same change and become afraid of the hares?

Other experiments, we are told, were tried with analogous results. Thus a glyceric extract of courage was obtained from a young lion, the olfactory nerves of a dog being again used as the collecting medium.

A difficulty which must make us hesitate before ascribing animal antipathies to some disagreement in their souls, making itself known by their specific emanations, is the following: the animals of uninhabited islands when they first come in contact with man entertain no antipathy for him, until his propensity for indiscriminate slaughter is learnt by experience. Can we assume that his emanations have changed in the meantime? Again, a colony of mice had established themselves at the bottom of a deep mine, doubtless to prey upon the provisions, candles, etc., of the workmen, and had flourished there for many generations. One of them, being captured, was brought up, placed in a cage, and shown to a cat. The cat prowled around and tried to get at its prey, but the mouse gave not the least sign of alarm. Why should the emanations of a cat be less alarming to this mouse than to any other? Is the tiger, our natural enemy—which, according to Prof. Jäger, bears the same relation to us which a cat does to a mouse,—any more offensive to us than certain animals which never prey upon man at all, such as the polecat or the skunk? If the timid man tempts the dog or the ox to attack him, on what principle does he diffuse panic among his fellow-men?

In short, Prof. Jäger's theory is beset with many and serious difficulties. Nevertheless, or, rather the more, we consider it entitled to a careful examination, both as regards its conclusion and the phenomena upon which it is based; the science of odors has yet to be constituted, and we are convinced that it will amply repay the needful trouble.—London *Journal of Science.*

SCIENCE AND SPIRITUALISM.

The recent publication of Professor Zollner's work in Germany, the death of Serjeant Cox, a distinguished lawyer and spiritualist in England, and the extended publication of Mr. Joseph Cook's lectures in this country have manifestly awakened a new interest in the alleged phenomena of what is called "spiritualism." So many communications have come to us from all parts of the country, the writers earnestly inquiring "why scientific men do not investigate the subject fully, and *settle* it once for all," that we are led to allude to the matter briefly.

In the first place, we will say that scientific men *have* investigated it, and published the results of their labors. In England, three representative men of the highest distinction, Wallace, the naturalist, Varley, the electrician, and Crookes, the chemist, have given the subject thorough experimental examination. Crookes devoted *four years* to the labor, Varley *seven*, and Wallace *ten*, and they state in the most decided manner that the alleged phenomena are actual and real. All these scientists are Fellows of the Royal Society, and they represent three of the most important departments of physical and natural science, chemistry, electricity, and biology. In Germany, five of the renowned professors in the universities, with Zollner at the head, have laboriously investigated the problem, and they also avow belief in the verity of the phenomena. In Russia, Wagner and Butleroff, professors in the University at St. Petersburg, after years of patient investigation, have reached similar conclusions. In addition to those named above, Dr. Franz Hoffman, of Wurtzburg University, Camille Flammarion and Hermann Goldschmidt, distinguished astronomers, and a large number of other scientific men in Europe, noted for accuracy of research and great acquirements, render the same affirmative verdict. In this country, the late venerable Dr. Robert Hare, of the University of Pennsylvania, gave five years of experimental labor to the subject, and he also became a convert. With him may be counted, perhaps, twenty other students in science, of less note, who coincide in his views.

Let us look at the other side. In England, three distinguished representative scientific men, Tyndall, Huxley, and Carpenter, entirely dissent from the conclusions and views of the three others named. Tyndall speaks of the "intellectual whoredoms of spiritualism." Huxley asserts that he "should have no interest in it if it was true." Carpenter, in a spiteful way, designates as "fools" all who take the trouble to look into the matter; and oracularly declares that "the whole thing is nothing but *unconscious cerebration.*" All of these gentlemen, like the others, are Fellows of the Royal Society.

In Germany, Zollner meets with a strong adversary in a distinguished professor in another university, who has written a "counterblast" to Zollner's book. The great naturalist, Carl Vogt, dissents, and so do Haeckel, Buchner, and Rolle. In this country, Agassiz was incredulous of the whole thing, and so, it would appear, are a large majority of the notable men connected with our colleges and universities. But it is quite impossible to learn the truth in this regard. A considerable number, as we personally know, express views in private which they are careful not to make known in public.

From the above brief review it will be seen that "spiritualism" in this country and Europe is regarded, among scholars and investigators, with about the same diversity of views as "Darwinism." On this continent the great names of Dana and Dawson, with numerous others, are counted as disbelievers in Mr. Darwin's theories; on the other hand, the young naturalists, with America's distinguished botanist, Professor Gray, at their head, incline to adopt his conclusions. In Europe about the same remarkable diversity in opinion is found among the great scholars and experimenters.

There is hardly any theory or doctrine in science upon which learned men are perfectly agreed, and it is not probable that this conflict of opinion will end very soon in regard to spiritualism or Darwinism. Whilst it is true that in investigations which so completely baffle the ordinary observer the thorough scientific man has a great advantage, he is still warped by prejudice, and there cling to him certain weaknesses common to humanity under all conditions. He is apt to adopt Faraday's views: "Before we proceed to consider any question involving principles, we should set out with clear ideas of the naturally possible and impossible." If we are to investigate nothing till we know it to be *possible*, the boundaries of the field of investigation become narrowed almost to a point. The notion is absurd. Nature is chary of her secrets, and we are not permitted to have any very clear ideas of what is *impossible.* Doubtless those who have investigated the subject under consideration have entered upon the work with all the prejudices and doubts natural to labor in such a field of mist and darkness, where tricks and fraud may be presumed to hold sway. The conclusions reached in the aggregate have been so conflicting that, so far as the world goes, nothing has been settled, and we do not see how it can become a clear matter of belief or disbelief among all classes from any investigations that may be undertaken, no matter how learned or exalted the individuals may be who enter upon the labor. To be sure, spiritualism rests upon alleged physical occurrences and facts, and so does Christianity, but science is incompetent to convince the world of the truthfulness or falsity of the later as well as of the former. Seeing is not always believing, and the most obstinate disbelievers in experimental results are among the co-laborers and associates of those who bring forward alleged results for consideration. Especially is this the case among those whose prejudices run counter to facts sought to be established.—*Boston Journal of Chemistry.*

ANTHROPOLOGY.

TERTIARY MAN.

TRANSLATED FROM THE FRENCH OF ZABOROWSKI, BY E. L. BERTHOUD, A. M.

"How far in past geological ages can we demonstrate the existence of man? We have to-day all necessary elements to give a satisfactory answer to this question.

Already in the beginning of 1864, M. Garrigou believed that he had proofs of the contemporaneity of man and miocene mammifers.

These proofs were bones of Dicrocerus Elegans, broken exactly like those from the quaternary caverns of France. Those bones came from the hill at Sansan, Department of Gers. Submitted to scientific discussion in 1868, this proof made no sensible impression. Nor did the so-called notches on a rhinoceros' jaw observed by Col. Saussédat from miocene strata at Billy, in France, obtain any greater credence.

M. Delaunay reported his discovery of incisions observed by him on the fossil ribs of a Haliterium obtained from the miocene cliffs of Pouance. These, for a long time, were attributed to the action of man. But in 1873, this position was abandoned by Delaunay and his follower, L'Abbe Bourgeois, and the incisions, on the advice and proof M. Hébert, were attributed to a shark, the carchorodon megalodon, that had probably once gnawed them when yet fresh. These fossils can to-day be seen in the museum of St. Germain.

Generally, the only objects incontestably of the miocene epoch, which bear traces of marks actually formed by the intervention of human agency, are the chipped flints of Thénay in the Department (Loire et cher.) These have been gathered by M. Bourgeois at a great depth in the ground, under a more recent deposit that yielded polished implements of flint. All these being in a much more recent quaternary stratum, while under them were miocene layers containing abundant fragments of haliterium, mastodon, acerotherium, etc.

The rough flint tools consist of scrapers, reamers, and small flint points, but all so roughly fashioned that everybody hesitated for a long time to take them for flint chippings, designedly so chipped.

M. Bourgeois presented the first ones found, to the congress of 1867. A few scrapers were then admitted to have been fashioned by human design, among those so agreeing being Messrs. Mortillet and Hamy. But when in 1873, M. Bourgeois presented some more new specimens found by him, to the same congress, opinions of their being the work of human hands, were much divided. But the scrapers were, however, recognized as genuine, some of them even presenting not only marks of fire, but have been shaped by aid of fire, the chipping having been employed only to correct the action of heat, and to modify the rough burnt forms.

M. Mortillet, after this, formed of this epoch of the first recognized human labor, the epoch of the "astonished stone"—in French, "Pierre etonnee,"—*i.e.* astonished or split up. Some of the flint tools are deeply altered and seamed by this action, nevertheless we can not admit, except with repugnance that the beings who constructed these flint chippings, were masters of fire, and capable of lighting it, if even of using it.

Were these beings in fact what we might call men? This question has been examined and discussed in all its different bearings by Messrs. Mortillet, Hovelacque and Gaudry, the Paleontologist, and decided by them in the negative.

It is known that animated beings on earth have followed a regular ascending scale, their most perfect developed forms, appearing in the order of succession as a development of former inferior types.

In all paleontological series, we do not see one group of highly organized beings appear on the arena before the appearance of an inferior ancestral group.

Hence, this law by no means would prevent us from considering the makers of the flint tools of Thénay, to be considered "a priori" as human beings.

The principal types of monkeys were already in existence in the middle miocene epoch; the single species of which numerous remains are now known is the "Mesopithecus Pentelici," from Greece. This simian was highly developed, and comes from the upper miocene.

M. Lartet has discovered two anthropomorphous monkeys in the middle miocene. Hence, an ancestrial form nearly human, could very well have appeared in this same miocene epoch without interfering with the laws of evolution. But there is not in the whole middle miocene, one species of mammifer identical with present species.

All species of animals and plants have been changed on earth since that period, and there is nothing startling in this when we reflect on the enormous period of time that has elapsed since the middle miocene period.

The Thénay flints occurred below strata that are middle miocene, that is the "Calcaire de Beance," then after this we have the upper miocene of Pikermi and of Vancleve; then we have the lower Pliocene; then follows the submerged forest bed of Cromer, in England; then above that the period of glacial boulder clays, of Norfolk; this to be followed by diluvium; then follows the Reindeer period; lastly our present age, "(Gaudry.)"

Since the end of the lower miocene, the mammalian fauna has been renewed at least three times, and between middle miocene and our present period there have been not only specific differences, but also generic differences.

(*To be continued.*)

A BURIED RACE IN KANSAS.*

BY JUDGE E. P. WEST, KANSAS CITY, MO.

Mr President, Ladies and Gentlemen :

I have the honor this evening of presenting to the Academy some additional facts hastily gleaned, upon a subject heretofore partially considered, and which tend further to strengthen the growing belief that a field, until recently considered barren in archæological remains, promises now, from developments of almost daily occurrence, to become second to none in interest in this respect. The appliances of our civilization are bringing to notice, in Kansas, a race unknown to history or tradition, and whose very existence, from any monument or vestige appearing upon the surface, might have remained unsuspected and unmarked forever, but for those appliances.

The district of country explored is in Marion county, Kansas, and extends from Florence, on the Atchison, Topeka & Santa Fe R. R., to four miles north of Marion Centre, situated on a branch of that road. This entire area, extending along the Cottonwood Valley and border of the low hills bounding it on either side, to use the language of my young friend Melvin Billings, to whose indefatigable researches we are indebted for most of the facts I lay before you, "is covered and underlaid with human remains." My own observations sustain the justice of this statement.

In the environment of the confluence of Clear Creek, Mud Creek, and the Cottonwood, in the vicinity of Marion Centre, there is evidence of three distinct races, which preceded our present civilization. Evidence of the most recent is to be found in the burial places of our modern Indians; next a hundred or more of low mounds or borrows containing human remains, such as fragments of pottery, stone and bone implements, ashes, charcoal, burnt clay, stone pipes, and human bones, testify to a greater antiquity; and evidence of the remaining, and most ancient race, is to be found in human remains without anything whatever upon the surface to indicate their presence.

These last are encountered in excavations for cellars, in well-digging, and in the cuts of the M. & M. P. R. R., a branch of the A., T. & S. F. R. R., before alluded to. The latter class of remains, especially on the low hills fringing the valley, are all, so far as I had an opportunity to observe them, found in a Lacustrine deposit, under a deep, black vegetable mold, and rest on the Glacial drift. This was the case at the cellars of Mr. Baylis and Mr. Case, at Marion Centre,

*Read before the Kansas City Academy of Science, May 25, 1880.

where human remains were found. At each place I observed the Drift cropping out on the hill-slope at a short distance from the cellars. I also observed drift pebbles, which had been thrown out from the bottom of each cellar. In digging a trench from Mr. Baylis' cellar a stone mortar was found at about the same depth of the cellar, and was covered over in filling the ditch and left remaining where found. But it must not be inferred that these two cellars are the only places where these mysterious remains are encountered.

Mr. Billings, in a former letter to me, says: "In the excavation of nearly every cellar and well in town some relic of aboriginal inhabitancy has been found." His residence is with his father, a short distance out of town, and, in the same letter, he says: "In digging a cistern at my home, one of these peculiar graves was struck, from which charcoal, burnt bones, flint chips, etc., were taken. In excavating the basement of our barn, 38 by 40 feet, seven of these graves were discovered." The M. & M. P. R. R. crosses Mud Creek some two or three hundred yards south of Marion Centre, and, in the same letter, Mr. Billings continues: "In grading the approaches to the bridges a large amount of pre-historic debris was discovered, among which are broken bone implements, stone arrow and spear points, stone axes, grooved mallets, rub stones, broken pottery, etc."

But the best observed graves of this kind, if graves they are, were found at the brick-yard of Mr. W. S. Moulton, one and a half miles north of Marion Centre. These were well examined by Mr. Billings and Mr. Moulton, and possess some very remarkable features independent of their evident great antiquity. The clay used by Mr. Moulton is a Lacustrine deposit containing lime connections, and is very similar to the Loess or brick clay in this city. It is three to four feet in thickness, only, covered by two feet of black vegetable mold, and rests on the Glacial drift. Mr. Moulton has removed the clay, in his brick-making, over a space of less than fifty feet, but in this small area he has found eleven of these buried repositories of the dead. They are cone-shaped, covered over with two feet or more of undisturbed vegetable mold, and all rest on the Drift. From a careful measurement of some of these, by Mr. Billings and Mr. Moulton, they were found to be fifty-four inches in diameter at the base, eighteen inches at the top, and thirty-six inches high; i. e. there is found in the clay, of these dimensions, a black cone-shaped mass of mixed ashes, charcoal, fragments of shells, intermingled, perhaps, with clay and containing human remains.

What is very remarkable, the base of the cone, at equal distances, sends out three triangular projections of about twelve inches in extent; and, still more remarkable, is the correspondence with this configuration of an ornamentation, or carved figure, on a fragment of the pottery found. The ornamentation seems to have been sculptured after the vessel was partially dried, and before burning. There is but a part of the figure or emblem on the fragment obtained, but there is enough of it remaining to associate it with the peculiar shape of the receptacles found imbedded in the clay, without any great stretch of the imagination. The part of the figure remaining forms an arc of a circle, with one of the triangular shaped projections based in it. All this will be better understood by the engraved representations in Figs. 1, 2 and 3.

The dark lines in Fig. 1 represent the fragment of pottery and segment of the figure remaining on it, and the dotted lines the lost segment, or the figure restored as supposed to have been sculptured on the vessel. Fig. 2 represents the base of the repositories as outlined in the clay. Fig. 3 represents a side view of the repositories.

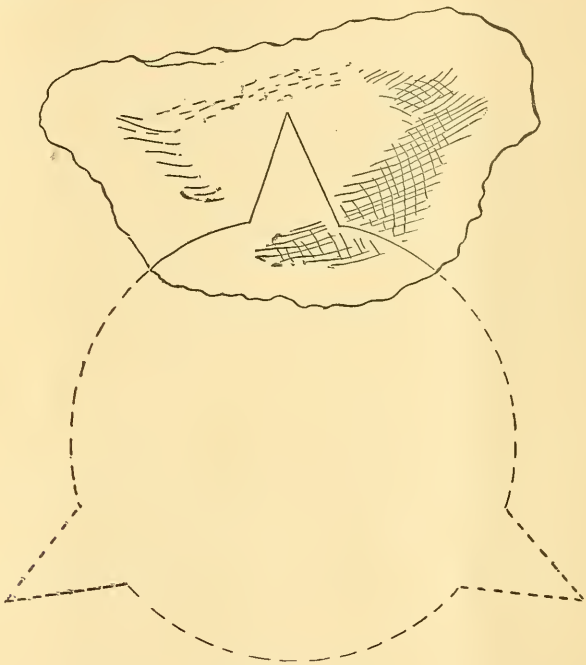

Fig 1—Full Size.

What is the peculiar shape of these repositories and figures emblematic of? Possibly of the sun. The people who conceived and fashioned them must have had some knowledge of geometrical lines and a considerable degree of intelligence.

All who have examined the repositories, without exception, with whom I have conversed, agree that the vegetable mold must have formed over them since they were made. They rest on Glacial drift, and must have been formed since that deposit. But the questions remain to be answered—were they excavated in the Lacustrine clay, or were they erected before its deposit and covered in by it? It seems difficult for a primitive people to plan and make an excavation of such shape; and these repositories may have been formed of some kind of cement upon the surface, before the Lacustrine time and covered by its deposits, and since undergone disintegration.

Marion Centre lies on the southeastern slope of the summit dividing the

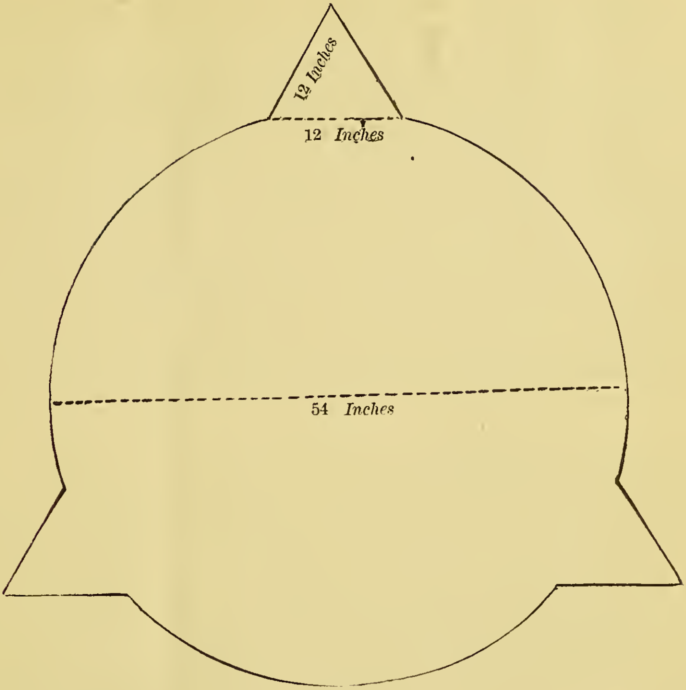

Fig. 2.

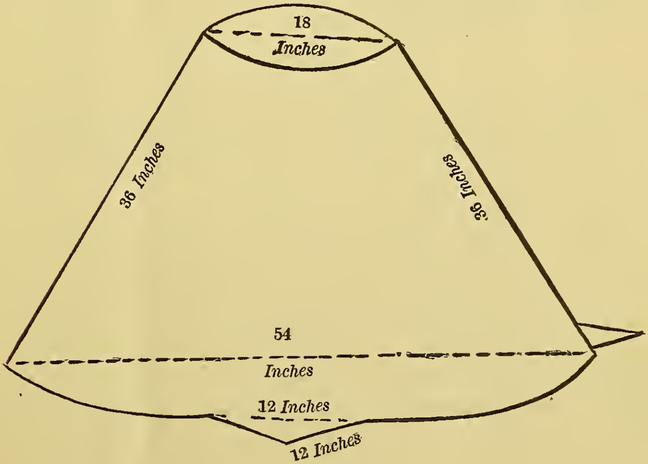

Fig. 3.

water-shed of the Arkansas river on the south, and the Smoky Hill river on the north, and is more elevated than the valleys of those streams on either side.

What connection, if any, these remains have with those I formerly described, found at a greater depth in those deeper valleys, remains to be determined by farther developments. If, however, they rest upon the Drift, as those here described do, and it is most likely that such is the case, the only difference would seem to be in the thickness of the covering over them, which would naturally follow from the differences in elevation when the deposit was accumulating, *i. e.*, if the lake water was four feet at the Moulton brick-yard and thirty feet at Ellsworth, supposing remains on the surface at each place when the deposit began, those at Ellsworth might be covered to a depth of thirty feet, while those at the Moulton brick-yard would only be covered four feet. Such remains might belong to the same race, if we suppose an occupancy prior to the submergence of the country.

It would require months of patient investigation to bring into order the facts connected with this very interesting and mysterious race, and I regret that I have not the means to prosecute the work; but hope some one more fortunate will do so.

The Glacial drift underlying the clay at the Moulton brick-yard is well marked and not to be mistaken.

The day devoted to these investigations proved to be tempestuous and rainy, but, by the kindness of my young friend's father, who placed a splendid team and wagon at our disposal, we braved the "tempest and the storm" and accomplished a good day's work. We visited several cellars, the Moulton brick-yard, some cuts on the M. & M. P. R. R., and took in mounds by the score.

The Atchison, Topeka & Santa Fe Railroad deserves great credit for the interest it has manifested in developing the beautiful country lying along its line, and the facilities it has generously afforded scientific explorations in Kansas, and merits the thanks of this Academy.

GEOLOGY AND MINERALOGY.

GEOLOGY AND EVOLUTION.*

BY THE LATE PROF. B. F. MUDGE.

CHAPTER I.—LAWS OF EVOLUTION. SILURIAN FOSSILS.

The doctrine of evolution is by means new. It is found in the oldest writings of antiquity, and appears to have secured a few believers in all ages. But it is only within the last hundred years that it has assumed a scientific garb. La-

* NOTE.—We present in this number of the REVIEW the introductory chapter of a series of articles written by the late Prof. Mudge on Geology and Evolution. Chapters IV and V of this series have already appeared in the REVIEW under the head of Botany and Evolution. While it is to be expected that many of the conclusions and deductions from his train of argument will be denied and objected to by the opponents of Evolution, these are nevertheless a valuable contribution to the literature of the subject, by one of the best observers of our day, and one who has had many opportunities of investigating this theory in connection with his favorite sciences—Geology and Paleontology. The articles are just as they came from his pen, with the exception of the necessary correction of a few obvious errors.—L.

marck, and, a little later, the author of Vestiges of the Natural History of Creation, and quite recently, Darwin and his followers, have given it a prominent position in the scientific world.

The strongest arguments and facts presented in support of their theory, have been based on living organisms. Our position on this question is, that the present period, or even the whole of the historic time, is far too short to settle the question of the evolution of the higher orders or genera, from the lower; and it is only in the long, long ages of geology that such changes can be studied with accurate results. To us it appears that geology must be the final arbiter in this great problem. We now propose to see how far this science can furnish evidence upon the subject of evolution.

In advance we state three laws which will guide us in the investigation, viz:

FIRST. *If evolution be true, it must be the ruling law, more or less apparent through all animated nature; or at least be seen in a majority of all species and genera of organic beings.*

SECOND. *That it should be most clearly observable in those species, whose fossil remains are most numerous and most widely disseminated.*

THIRD. *That the development from the lower to the higher type, should be symmetrical and harmonious.*

By the third law we mean that when animals are claimed to be derived from a lower form, advancement should be seen in all parts of the body, both internal and external, in the same degree. Prof. E. D. Cope, an advocate of evolution, has expressed the idea in the following terms: "The natural deduction is, that if a portion of an animal exhibits a form intermediate between two known forms or types, the remainder of the animal structure possesses the same kind of intermediacy."* He has endeavored to show a modification of this rule in some cases, but the main principle stands unchanged.

We think these three laws may be fairly and candidly deduced from what we already know of the operations of nature; and are not inconsistent with the principles laid down in the writings of Prof. Darwin and his associates.

Now if the student in fossil remains finds forty-nine out of fifty of the most abundantly preserved species, showing no marked change, over large areas and during long geological periods, even if the remainder should present some apparent development, in a slow degree, he has a right to conclude, that evolution is not a law of nature, and that no high type has arisen or can arise from the lowest.

There are about 50,000 known species of fossil plants and animals. Some of these are represented by very few specimens, others by hundreds or thousands, and not a few by millions. We consider ourselves justified in saying, that at least one-tenth part (5,000) are sufficiently numerous and well preserved to show the changes of evolution, if it exists.

It is apparent that in all animated nature, there is a great diversity in the appearance of different individuals of the same species. But we take the position,

* Cretaceous Vertebrata, p. 8.

which we believe we can prove, in the following pages, that this constant, ever present variation is always within a narrow limit. Thus, no two oysters, horses or men are just alike, but their varied appearance is within a narrow circle. No two members of the human family are just alike, yet we easily detect the German, French or Irish element, yea, even family traits, in the men we daily meet. This constant variation, is accompanied by an equally constant adherence to the normal type. No two sharks are just alike, and different genera and species have a regular variance from each other, but the microscopic cell-form of the shark's tooth, as given by Owen in his Odontography, is the same in the earliest tooth of the Devonian and in all later geological strata, as well as in the living sharks of our ocean. No two pine trees have the same shape, yet the cell-form of the wood, so small as to require a strong magnifier to see it, is always of the same elongated shape and with the same marking, whether from the Devonian age or from the living Auricarian pine. This unyielding persistence will be brought in view in the examination of the varied phases of organic life.

In looking at the facts of geology the great rule is apparent that in a very general way the oldest fossiliferous strata contain only low types of animal and vegetable life, while the later formations contain higher forms, in proportion as they become more modern. This general rule, however fails in detail, as we shall endeavor to show. The oldest Silurian does not begin with the lowest forms of the five great sub-kingdoms of animals, as it should according to the laws of evolution, but has numerous representations of four sub-kingdoms, viz: Protozoans, Radiates, Mollusks and Articulates. The Protozoans, which are the lowest, and consequently according to the theory of evolution, should be the earliest and most abundant, are not found at the first; and when found are the least abundant of the Primoidal found. The representatives of the Radiates, Mollusks and Articulates, are not the lowest of their kinds. This fact was thus strongly and clearly stated at a recent meeting of the British Association by Dr. Thomas Wright, President of Section C. "Instead of a gradation upward in certain groups and classes of fossil animals, we find on the contrary, that their first representatives are not the lowest, but often highly organized types of the class to which they belong. This is well illustrated in the Corals, Crinoids, Asteridæ, Mollusca and Crustaceæ of the Silurian Age, and which make up the beginnings of life in the Palæozoic period. The fishes of the Old Red Sandstone, we have already seen occupy a respectable position among the Pisces; and the Reptiles of the Trias are not the lowest form of their class, but highly organized Dinosauria."

Dana* also says, "If we may trust the records, Echinoderms, or the highest type of Radiates, were represented by species (Cystids and Crinids) long before the inferior type of Polyps existed.†"

The examination of the Silurian fossils in detail are instructive on this point. Barande in his valuable publications on the Silurian, has given us the results of his studies on this system from twelve district regions. Dividing it into three

* Nature, Aug. 2s, 1875, p. 357. † Mammal, p. 598.

periods he tabulates the fossils of the first division. From this he reports from the four sub-kingdoms above named, 366 species. Of these, 264 or seventy-two per cent belong to Crustacea, the highest of these sub-kingdoms. So while on theoretic grounds only the lowest sub-kingdom should have been represented, the highest outnumbers all the others by nearly three-fold. In abundance of individual specimens, the trilobites, the most common crustaceans, outnumber by a hundred-fold all other fossils in the first division of the Bohemian Primordial. Barande further states that the families and orders are entirely without transitional forms.

If we examine all the fossils of the Silurian Age, we shall find a somewhat similar result. Barande gives 10,074 as the number of Silurian Species known and described up to 1872. Of these only 153, or less than two per cent, are Protozoans—1,306 or thirteen per cent are Radiates, while 2,112 or twenty-one per cent are Crustaceans. It will be seen that the highest, though not as numerous as the next lowest sub-kingdom, contains more than both of the lowest two. This proportion in favor of the Crustaceans is greater than exists in the living species.

If we examine the number in the classes of the Mollusks we shall find results, though not as strong, still in favor of the highest. Cephalopods, the most complete in organization, are the most numerous. It will also be seen that there is no order or harmony in the number of each class. Placing them in the order of their rank we have in number of species and percentage;

Cephalopods	1,622 . . .	.27
Pteropods and Heteropods . . .	390 . . .	.06
Gasteropods	1,316 . . .	.22
Acephala	1,086 . . .	.18
Brachiopods	1,567 . . .	.26

The EXTREMES are most strongly represented.

Much has been said about the possibility, that all animal life has been derived from the Ascidian. If so, it should appear among the earliest fossils. But it has never been thus found. It has been asserted that because it has no solid parts it could not have been preserved if it had existed. It has a tough leathery exterior, far more firm than many an animal found fossilized. We have the impressions of the soft bodies of spiders preserved in the Carboniferous rocks; and 185 species of worms have been described from the Silurian. Our marine plants found in all geological ages, are of softer texture, yet we find their outlines well preserved. Besides, the living Ascidians are frequently covered by the calcareous material of Bryozoans, which would aid in the preservation of the leathery sack. No intermediate form between the Ascidians and the vertebrates exist among fossils. The size of many species, eight inches and over, would enable them to be easily seen, if only the outline had been preserved.

To any one who has studied the character and relations of the fossils of the various geological formations, it is very clearly discernible, that while the first forms are not like the animal life of the present day, they are very far from being

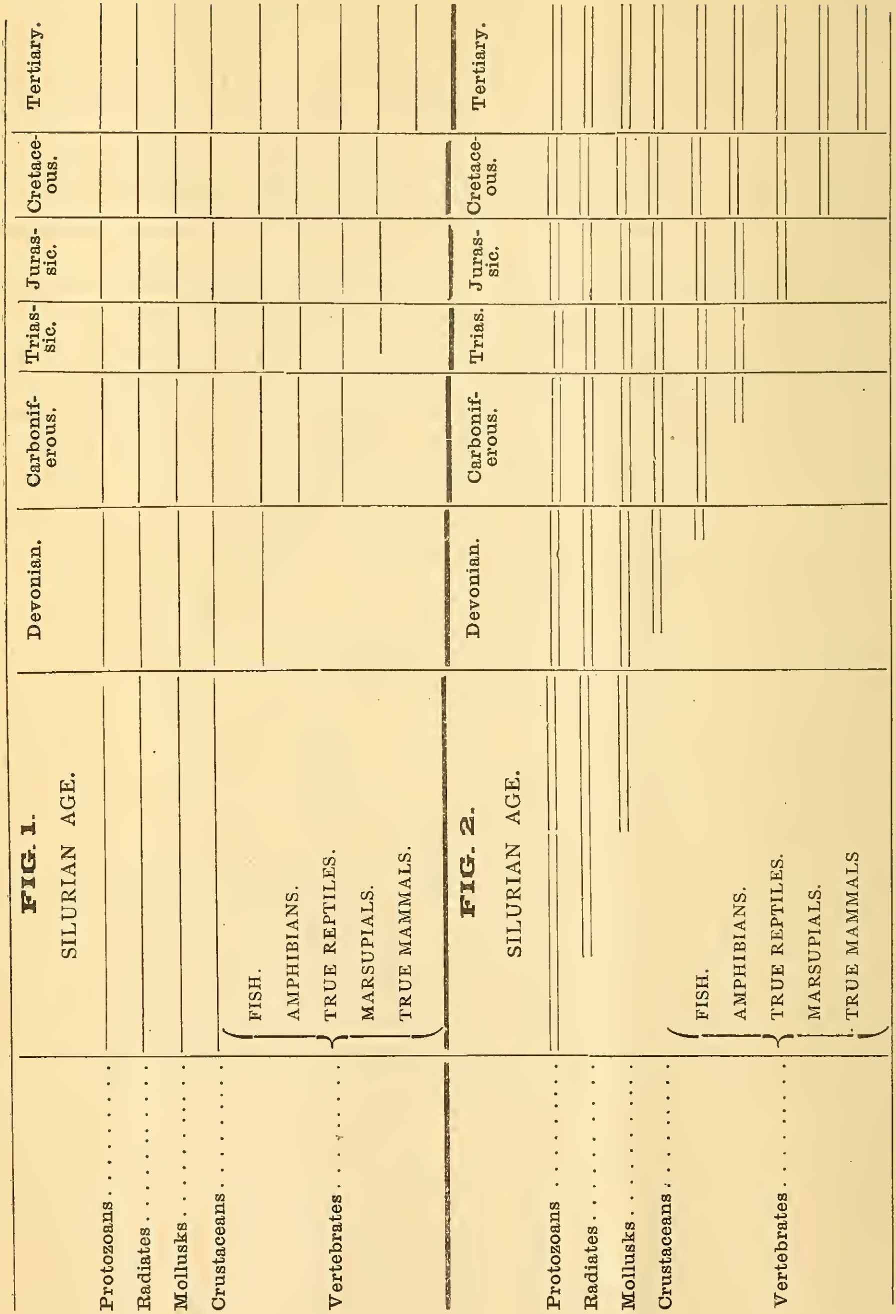
FIG. 1.
SILURIAN AGE.
Devonian.
Carbonif-erous.
Trias-sic.
Juras-sic.
Cretace-ous.
Tertiary.
Protozoans
Radiates
Mollusks
Crustaceans
Vertebrates
FISH.
AMPHIBIANS.
TRUE REPTILES.
MARSUPIALS.
TRUE MAMMALS.
FIG. 2.
SILURIAN AGE.
Devonian.
Carbonif-erous.
Trias.
Juras-sic.
Cretace-ous.
Tertiary.
Protozoans
Radiates
Mollusks
Crustaceans
Vertebrates
FISH.
AMPHIBIANS.
TRUE REPTILES.
MARSUPIALS.
TRUE MAMMALS

in harmony with any system of development. To show this the more plainly to the eye, we have given two Figs.—1 and 2, exhibiting the times of the appearance geologically of the various forms, and also the relative periods at which they should have appeared according to the system of evolution.

Fig. 1 is condensed from Dana.* It will be seen from this that four of the five sub-kingdoms of animal life—all but the vertebrates—came in together at the beginning of the Silurian, when if there was in nature a systematic plan of development, the Protozoans should have appeared first, and the others followed in the order of their organic rank. The latter idea we have endeavored to show in Fig. 2. We have divided the time nearly equally between the fine sub-kingdoms. This may be giving the lower forms more importance than they deserve for they are not equally dissimilar in the degree of their organization. But it is usually stated by evolutionists, that the lower the type the more slowly is the change of advancement. This we think justifies the statement that the time required for the Protozoan to become a Radiate would be as long as for the highest Crustacean to become a Vertebrate. Our tables in Fig. 2 may not be entirely accurate, but they are certainly so approximately. It is enough to show how entirely antagonistic are the facts of the earth's early history to the theory of development. The great difference of life rank, between the different sub-kingdoms, is admitted by all Zoölogists.

Similar tables (see Figs. 11 and 12) in relation to the geological and theoretic appearance of vegetration, gives nearly the same results.

NOTE.—We have commenced, in our geological history and observations, with the fossils of the Lower Silurian. The fossils below that age are so few and obscure that they throw little, if any, light on the subject under discussion. Whether Eozon Canadense is organic, is an unsettled question in the scientific world.

Dana in referring to the oldest Silurian fossils has stated that they were not less than fifty millions of years old. We shall use that standard of time, in the following pages, though most European geologists assume a much longer period. [See appendix for the Geological Ages and Periods.]

PRECIOUS METAL MINING IN THE UNITED STATES.

BY N. S. SHALER.

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The fields of the precious metals in the United States may be generally divided into two principal areas, that of the Appalachian and that of the Cordilleran ranges. Besides these there are the smaller regions, which may be termed in a similar fashion, from their neighboring mountains, the Laurentian, including the region about Lake Superior, and the Ozark region about the mountains of that name in Arkansas and Missouri. There are lead ores in several of the States of the Mississippi Valley, at great distances from these mountain ranges, that contain a small proportion of silver, but in few cases does this silver exceed about the four or five thousandth part of the ore; nor is there any chance that they will ever produce this metal in quantities of the least commercial importance.

*Manual, pps. 386 and 589.

The whole of the rich agricultural region of the Mississippi; the whole of the Western plains, through all their extent to the one hundred and second meridian west from Greenwich, and on their northern section to the one hundred and tenth meridian; the whole of the low-lying plains of the Southern States, in all containing a little over one half the total area of the United States, but at least nine tenths of its arable land, is sure never to prove productive of any the metals now known to the arts, save iron, lead, and aluminium; and of these lead will never be again economically produced there, until the mining industry of the Cordilleran region begins to wane.

This rejection of the larger part of national area from the list of regions where gold and silver may be found in profitable quantities is based upon actual experience of the generations grown up within the area, as well as the general fact that the experience of other countries shows us that such rocks as underlie this region are always marked by the absence of gold and silver in profitable quantities.

Of late years there has been a great advance toward a learc understanding of the natural processes by which metallic deposits are brought into the shape in which the miner finds them. All the old notions about the outburst of mineral veins, by fiery ejection from the deep interior of the earth, have been cast aside. Geologists now pretty generally recognize the fact that all our metals are deposited in our stratified rocks as they are laid down on the sea-floor, having been separated from the sea-water, as a great part of all the rocks are, by the action of sea-weeds and marine animals. * * * * * *

Whoever looks over the whole field of American precious metal mining will be convinced that this industry is certain to make a very rapid growth in what is left of this century. He will also come to the conclusion that the production of silver is destined to increase very rapidly for a score or so of years to come, provided the demand for this much slandered metal does not fall too far short of the supply. Beyond a brief term this yield of silver will surely diminish, especially if there is any considerable lowering in its price. The observant eye can also see that the production of gold is likely to extend to many new fields, and that the yield of this metal is in the future likely to be rather more steady than that of its bulkier sharer in the greed of men. North America and the twin continent on the south are doubtless to be the great producers of precious metals in the future; their store of silver must be of greater value at the present price of this metal than their store of gold. If the world continues to use silver in the coming century as it has in the past thirty centuries, there is a fair prospect that our continent will win some thousands of millions from its silver-bearing lodes. Even if we make what seems to me the mistake of using gold alone as a basis of exchange, the production of this metal will no doubt give us a larger mining industry than any other country can expect to gain.—*June Atlantic.*

ENGINEERING.

ASPHALT PAVEMENTS.

GEN. Q. A. GILLMORE, U. S. A.

Within the last twenty-five years bitumen, in some of its many forms, has been employed to a considerable extent, as the binding material or matrix for road and street coverings laid in continuous sheets without joints. They are all comprised under the general head of asphalt pavements. The city of Paris took the lead in this innovation upon the former methods of paving with stone, the reasons assigned for the change being, (1) the want of connection and homogeneity, in the elements of which the stone paving is composed, (2) the incessant noise produced by them, (3) the imperfect surface drainage which they secure, by reason of which the foul waters are not carried off but filter into the joints, and (4) the ease with which they can be displaced, and used for the construction of barricades, breastworks and rifle pits in time of civil war.

The forms of bitumen most extensively employed for pavements are *mineral tar; asphalt rock*, which is an amorphous carbonate of lime impregnated with mineral tar, and known in commerce as *bituminous limestone; asphaltuu;* heavy *petroleum oils* like those from West Virginia, or others not volatile under 212 Fah., or the residuum of refined petroleum containing no water, and so refined as not to be volatile at 212 Fah.

The principal sources of the natural mineral tar of commerce are in France, at Bastenne (Landes) and at Pyrimont Seyssel (Ain), and in Switzerland at Val de Travers, in the canton of Neuchatel. At Bastenne as well as at Gaujac, in the south of France, it flows frome sevral springs mixed withwater.

Asphaltum is a variety of bitumen generally found in a solid state. At rodinary temperature it is brittle, and too hard to be impressed with the finger nail. It is black or brownish in color, opaque, slightly translucent at the edge of a new fracture, of smooth fracture, and has little odor unless rubbed or heated. It melts easily, burns with very little if any residue, and is very inflammable.

It is found floating on the Dead Sea, and in many places in Europe. Many localities in Mexico supply it, and it abounds in the islands of Barbadoes, Trinidad and Cuba, and in Ritchie county, West Virginia, and in New Brunswick, Dominion of Canada.

A capital distinction must be made between pavements of asphalt hereafter described, made either with natural asphalt rock, or with the refined asphaltum as a cement, combined with suitable calcareous powder, and all or nearly all of those attempted imitations of it, produced by mixing crude mineral tar, or manufactured tar, with one or more pulverized minerals or earths. And more especially must we exclude from the category of asphalt pavements, all those patent street coverings composed of wood-tar, coal-tar, pitch, rosin, etc., mixed with either sand, gravel, ashes, scoria, sulphur, lime, etc., or with two or more or all of them. Some of them will produce a tolerably fair sidewalk, but they are totally unfit for the surface of a carriage way. Some of the best of them will answer for carriage way foundations.

The rock should be of the fine grained variety, of tolerably close texture, and composed of pure carbonate of lime so uniformly and homogeneously impregnated with the bitumen, that a cut made with a sharp knife will show neither pure white nor jet black spots, but be of a brownish liver color, mottled with gray.

When asphalt rock of this character is heated to a temperature of 200° to 212° Fah., the bitumen becomes soft, the grains of limestone separate from each other, and the mass crumbles into a partially coherent powder. If this powder while still hot, be powerfully compressed by ramming, tamping, or rolling, the molecules will again unite, and the mass when cold will assume all the essential qualities of the original rock, but in a superior degree, as regards toughness, hardness, and incompressibility. This is the whole theory of asphalt road coverings, as applied to the street pavements in Paris and elsewhere.

Mention has been made of the superior toughness, hardness and incompressibility, conferred on bituminous limestone by compressing it while hot. This property characterizes any genuine asphalt mixture suitable for paving purposes, and advantage has been taken of it, in first forming the material into rectangular blocks under a heavy pressure, and then laying them in courses across the street, substantially after the manner followed in constructing the best stone block pavement. It is, perhaps, needless to say that a pavement of this kind, composed of good materials, properly prepared, and laid upon a firm and unyielding foundation, should be a good one. Specimens of it have been on trial for some years in San Francisco, Cal. The blocks are made with Trinidad asphaltum, softened with 7 to 9 per cent. of the heavy oils or still bottoms, used in preparing the asphaltic cement. This preparation is mixed with hot powdered limestone, or powdered furnace slag, and then compressed with a force of about fifty tons into blocks measuring 4 inches by 5 inches by 12 inches. The pressure, which is applied to the narrowest face of the block, exceeds one ton to the square inch. The limestone or slag is not required to be of the fineness of impalpable powder, but is composed of grains of all sizes from dust up to the size of a small pea.

The blocks are laid close together on their longest edges, in courses across the street, breaking joints lengthwise of the street, the joints being filled with suitable asphaltic cement so as to render the pavement water tight. The foundation should be firm and stable, such as the best of those described on pages 143 to 149. This pavement while new would be nearly as smooth as that of the continuous sheet of asphalt heretofore described, but the wear of heavy traffic would, in a short time, crumble off the edges of the blocks and open the joints at the surface sufficiently to give the horses a foothold, without impairing the imperviousness of the covering. It is suggested that it would be better to form the blocks with slightly truncated or rounded edges, so as to give the requisite foothold when the pavement is laid, rather than to secure the same end by the irregular and ragged abrasion caused by use. As they are homogeneous in toughness and hardness, the blocks can be taken up, and their surfaces become uneven from unequal wear, and relaid in mortar, bottom side up, with all smoothness of a new pavement. It may be added that the process of refining and careful manipulation, is equally necessary whether the material be applied as a monolithic sheet, or as blocks, and any mixture that is suitable for the former is also suitable for the latter; also, that a form of sand is not a proper foundation in either case.—*Roads, Streets and Pavements.*

THE HUDSON RIVER TUNNEL.

The work of tunneling the Hudson River is pushing steadily on, and it is expected that in three years from now trains arriving in Jersey City will run directly through to New York, and land their passengers in Broadway, somewhere near the Metropolitan hotel, in six minutes' time. The company says that more than 400 trains of cars could be passed through in twenty-four hours on the double track.

Freight trains will use the tunnel exclusively at night, and market trains in the early morning. All will be drawn by engines made especially for the purpose. These will consume their own steam and smoke. A powerful engine will be always at work forcing air into the tunnel. The entire length of the tunnel will be 12,000 feet; that is, about one mile under water and three-quarters of a mile on each side. Thus far only the New Jersey end has been bored, but the work on this side will soon be begun and excavations will proceed from both banks until they meet. As many men will be kept constantly engaged day and night, as can be successfully employed at once, in making the hole and building the lining wall. The gangs will be changed every eight hours, thus doing three days labor every twenty-four hours. All the work will be done by electric light. The tunnel will be lined throughout with iron plates, and these in turn will be faced all over with the best hardened brick and hydraulic cement, three feet thick. The brick will be made from the refuse taken from the tunnel. This, it is said, will effect a saving of $2.25 on every thousand used. As there will be 2,013 brick in each running foot of wall, it will be seen that the saving is considerable. The interior will be painted white and lighted with gas. The entrance in Jersey City will be from Jersey avenue in Fifteenth street. The tunnel will be a single one, twenty-six feet wide and twenty-four feet high in the clear down to within a few feet of the river on both sides, and a double one all of the way under the water where the two tunnels will run side by side, each eighteen feet high and sixteen feet wide in the clear. It is to extend from Jersey avenue to

Hudson street and the river, about 3,400 feet; thence under the river, curving five degrees northward to the New York bulkhead line at or near the foot of Morton street, about 5,400 feet, then curving slightly southward in New York, about 3,000 feet, to a point to be selected by the city authorities. The extension grade of the tunnel is two in 100 feet descending from Jersey City, then ascending on the New York side three in 100 feet for 1,500. From that point the ascent will be on a grade of two in 100 feet to the New York end. The greatest depth of water in the river is about sixty feet. Most of the bottom of the river bed is composed of tenacious silt, underlaid by hard sand. Near the New York shore a small extent of rock is encountered and some gravel.—*St. Louis Journal of Commerce.*

CHEMISTRY.

BOG BUTTER, FROM COUNTY GALWAY, IRELAND.

Mr. John Plant, F. G. S., exhibited at a meeting of the Manchester, England, Philosophical society, January 19, 1880, a piece of mineral resin, familiarly known in the west of Ireland as Bog Butter, (Butyrellite). The lump weighed exactly 14 ozs. It came from a good depth in a bog in County Galway. A few years ago, when in that part of Ireland, he had been unsuccessful in meeting with a sample of this curious substance, although he was informed that it was not unfrequently met with by the turf cutters during each summer. He heard of its origin and some of the uses to which it was said to be put by the poor people, if they got any of it, from a farmer at Killkee, but he could hardly credit the statement that in hard times it was melted down and actually used as a dripping to the potatoes; he rather concluded that the greasing was limited to the axles of the potato cart. The Irish have a widespread belief that bog butter was hidden by the fairies in the bogs long ages ago; and it is affirmed that the butter is sometimes found in small wooden kegs in bogs along the coast. These kegs they say have been hastily buried by smugglers running a cargo of contraband, though when bog butter was declared an illegal article of trade in Ireland they are unable to say. Unfortunately, Mr. Plant was not shown a keg, or even a staver of a keg, but he was informed that specimens of veritable kegs of bog butter are to be seen in the Museum of the Royal Irish Academy and in the museums at Edinburgh. The fairy origin of the bog butter he thought might be ascribed to the active imagination of the Celtic brain, many of the inexplicable things in nature being readily put down to the good or evil doings of the indigenous fairies of Erin.

By the aid of scientific analysis the substance called bog butter can be shown to be a perfectly natural production arising from the decomposition of the vegetable matters forming the peat or bog, and to belong to the numerous family of mineral resins, or hydrocarbon compounds, of which Dana describes the composition of seventy species.

Many of these are very well known under the names of marsh gas, petroleum, ozocerite, asphaltum, naphtha, paraffin, bitumen, amber, torbanite, coal, and its varieties.

Some of these singular minerals are obtained only from bog and peat beds

Some time ago Mr. Plant showed to the Section a quantity of one of these resinous minerals, which occurred under the bark of pine logs found in a moss at Handforth by Mr. P. G. Cunliffe. It proved to be known in Germany as Fichtelite, but had not before been known to occur in Great Britain. Afterward it was found in pine logs in the peat on Lindow Common. A waxy, greasy, or butter-like character is distinctive of these bog products. The one now exhibited was described first by Brazier in 1825, and was analyzed by Willamson in 1845, its composition being given as

Carbon	73.78
Hydrogen	12.50
Oxygen	13.72

When fresh from the bog it is soft and like butter, but hardens in drying. The mass is dirty and bogstained on the outside, but inside pure white and free from impurities. It melts at 50° C., and becomes a yellow greasy resin; dissolves in alcohol or in ether, and then crystallizes in beautiful needles. When heated it gives off a peculiar odor like acroline. By saponification with potash it yields an acid which Brazier proves to have a composition similar to palmetic acid.

There is a mineral waxy resin called Guyaquillite, which is found in extensive deposits in the marshy plains near Guyaquil, in South America, which has a similar composition to bog butter.

Johnson gives it as

Carbon	76.67
Hydrogen	8.17
Oxygen	15.16

It has been proved that the slow decomposition or change in the vegetable peat or moss will produce elements of which these hydrocarbons are made.—*Chemical News.*

CARE OF STOVES.

The season is at hand for removing stoves from the rooms they have warmed during the winter. A few words of caution may not be amiss. Iron is more sensitive to the hygrometric changes in the atmosphere than any other commonly used metal; at least it is more susceptible of permanent injury from dampness. The planished surface sheet iron, known as the Russia iron, resists these insidious approaches of the foe of metals much better than our common iron; but there is no mechanical means known of so thoroughly compacting the outer fibers of sheet iron as to prevent the action of moisture. Unused and uncared-for Russia sheet iron, unless kept in a place of equable dry temperature soon shows pin spots and blotches, like mold, and these are the beginnings of disintegration. Those stoves which use wood or charcoal as a fuel, or for kindling, are particularly liable to decay. The inside of the stove and the pipe are attacked by the pyroligneous acid contained in the soot and soon show the effects after being taken down. So long as a fire is kept up the heat counteracts, in some measure, the attacks of the acid; but when put away for the summer the soot has opportunity to act, especially if it is aided by the damp atmosphere of a cellar, or the variable draughts of an outhouse. The garret, or a room above the living rooms, is the best place for unused stoves and funnel. Perhaps the time will come when the superior advantages of sheet brass to sheet iron will be conceded, and our sheet metal stoves and pipe last a generation and grow handsomer as they grow older. Brass—any of the alloys of copper—is preserved from decay by its atmospheric oxide. The rust of brass preserves the metal and ornaments the surface. The oxide of iron disintegrates and "kills" the metal and disfigures the surface. Cast iron is worse in its objectionable features. A cast iron stove once rusted is a deformity and an eyesore. No amount of "Rising Sun" or "Carburet of Iron" can restore its pristine beauty or conceal the ravages of rust. The only way to preserve for the summer our red hot winter friends is to keep them in an equable atmosphere as to humidity; don't let them dry up through negligence nor weep out by carelessness.—*Boston Journal of Commerce.*

EDUCATION.

SOME THOUGHTS ON THE PRINCIPLES OF INSTRUCTION.

BY PROF. E. C. CROSBY, KANSAS CITY, MO.

Thoughtful comparison of our best common schools with schools of an earlier time, suggests the conclusion that, although we are struggling in the dawn of a better age, we have hardly escaped from the traditional empiricism which forms the literature of the past. Probably, one of the greatest obstacles to progress is the paradoxical aversion of teachers themselves to scrutinizing their own methods with the same interest and persistence manifested by them in pursuing light literature, society, fashions and gain.

A child of six years must attain some proficiency in many subjects, if he would leave the school room, at the age of seventeen, respectably intelligent. Hence, arises the question, "What subjects should be pursued during these few years?" But this question is inappropriate to the case at hand. Let us see.

It is autumn, and the fruitful farm groans under its splendid burden; but last night a destructive fire swept away every tool and instrument, save one, with which to gather the crops. Suppose the farm is sold to a foreigner who is unacquainted with our farm implements. There are the fruits to be gathered and shipped, the wheat to be stored, the corn to be husked, the field to be plowed, &c., and there is but one instrument with which to do the work. His first inquiry evidently is, "What kind of work will this instrument perform?" and not "Which crop shall I gather first with this instrument?" Now, mind is the sole instrument with which the educator deals, and, evidently, his first question must be, "What kind of work will this young mind perform?" and not the question, "Which branch of study must first be mastered?" The profounder educational questions, then, underlying all others, are: What are the principles of mental action? What are the elemental acts in the process called "knowing"? These questions carry with them not the tacit but the living assumption that mind, in its several departments of intellect, sensibilities and will, is an indication, an expression of law; and it matters not to the present view whether that law be surmised or wholly unknown. This point settled, then, let us proceed to consider the questions: How do we acquire? What mystery lies concealed in the dawning of intelligence? How are mental faculties aroused to discharge their several functions, and in what order of succession? To answer these questions, we need to consult only our own experiences as simulated in the daily activities of a child. A simple illustration: A book falls to the floor; the floor trembles; the air quivers; the drums of the tympanum vibrate, and the internal ear transmits the vibrations to the nerve which carries them to the brain; terminating this series is consciousness of sound. An idea of sound is subsequent to these physical movements, which it could never precede. Without the former, the latter could have no existence. Likewise, the child can never have the thought of heat until its nervous organism has been affected by heat. In these acts of knowing, it would be difficult to determine whether the *sentiens* is more important than the *sensum*, but it is quite unimportant, since neither is dispensable. An object must be perceived before it can be conceived. It must become to us an object of sense before it can become an object of thought. It must first be presented before it can be represented. Ideas of roughness, area, elasticity, form, attraction, law, are based upon, are awakened by or arise from perceptions, and never precede them. And, generally, Frœbel's system is the only practical philosophy of education extant.

The class in Physics recites—no apparatus to illustrate the subject. The pupil answers: "A body is in stable equilibrium when it will return to its former position after it has been slightly disturbed." Well recited, but what does that mean? Illustrate. Here is a cone—explain your definition. Several attempts, failing to clear up the definition, succeed in showing a total want of comprehension of stable and unstable equilibrium. Success is reached only after many questions and failures. Here it is clearly shown that a definition is the result of purposed investigation, and the result illustrates the truth that the mind is not a crib for storing away forms of finished knowledge, like the above definition, unless those forms have become the child's possession by tentative and experiential efforts. The mind, rather, is an instrument fitted for hewing out or modeling the knowledge products which it will possess. To begin with a definition is to begin at the wrong end of the educating process. It is much like getting a warranty deed to real estate before ascertaining its location, desirability and value. A definition, a generalization, a rule, a law, is a product of numerous observations and comparisons—a conclusion, the *finale* of a thousand experiences. The same truth is even more strikingly illustrated in the student's attempt to know the meaning of chromatic aberration, if presented to him in the form of a definition, clearly stated, with not more than fifteen words. Correct instruction requires the teacher to take his pupils to the glad fountain of experience, where the elements of knowledge and their symbols are severally known; where they may be individually studied in their relations to each other; where they may personally encounter obstacles and feel the glorious enjoyment of surmounting them; where, individually evolving the finished forms of knowledge for themselves, their exact contents will be known rather than solely the æsthetics of expression.

The necessity of perceiving completely and the trained ability of interpreting sensations are not outranked by any other department of educational science. A single illustration: A child sees a rock-salt prism for the first time. Vision alone is concerned. The child's conception of the prism consists of color, form, transparency and position. On the following day it handles the instrument. Now, the child's conception embraces, besides color, form and position, smoothness, temperature, resistance, solidity, weight, etc. Upon the third day, the senses of sight, touch and hearing are applied to the study of the prism. Now, its conception becomes far more complex. At the close of the fifth day, when the experimental process has been tolerably complete, let the question be asked, "Upon what day does the child possess the most perfect idea of the prism?" The answer is self-evident, likewise the reason. The greater the number of sensual experiences, both in number and in kind, brought to bear upon an object, the more accurate, positive and considerable is our knowledge of it. The mind has been reached by different avenues of sensation, the soul has been awakened to new life, true conceptions have been formed, and these have been correlated and harmonized by the individual activities of the mind to be improved, while they possess all the force, weight and power which it is possible for those conceptions to possess. Here is the practical question which more deeply concerns every parent: Should the schools possess the apparatus which will furnish the opportunity for these experiences? There can be but one answer.

I know it is a great mistake to think that when pupils arrive at their "teens" they have passed the period which makes experimental work a necessity. This common belief might have some probability in it, did they receive the proper training before arriving at that age. Prof. Cook, our American chemist, in a lecture delivered before the summer school of chemistry, (1879,) declared that "students coming to the university can neither observe with any accuracy nor are they able to draw tolerably correct inferences from what they imperfectly observe;" that "the student should be brought into personal and original contact with facts, and, by practice, become able to draw correct conclusions from them; for these reasons, I find it necessary to take personal charge of the elementary classes, leaving the more advanced ones to the tutors." The same notes of warning and complaint have long been uttered by such educators as Porter, Bain, Agassiz, McCosh, Gore, Spencer and others who stand among the best teachers of our time, and still we continue in the grooves deep-worn far back in the Middle Ages—grooves so deep that he who attempts a statement of the principles which underlie acquisition is charged with being a "theorist," and his work is denounced as "not suited to the wants of the teacher," or as "shooting over our heads." Similar is the history of every move forward.

From whatever quarter we approach the fundamental principles of the educating process, there should be:

In Childhood.—Perceptive work, with few symbols.

In Youth.—Perceptive work, with many symbols.

In Manhood.—Symbols, not exclusively.

All theories of intellectual and moral discipline, devised by ingenious persons, disregarding the truth that law reigns among mental phenomena no less than among physical ones, must pass into forgetfulness, supplanted by one which rests upon the unalterable and eternal truth, so unmistakably illustrated in every human experience, and so concisely formulated in another century, that all our knowledge begins with experience.

It is well known that our educational system fails to cultivate and develop practical judgment, and this failure demands an explanation which will stand adverse criticism. I believe it a truth that is almost axiomatic, that every problem in mental economy and mental discipline must find its solution, ultimately, in the nature of mind itself. Education begins with sensual experiences, but it does not end with them. When these experiences have been made the child's possession by an exercise of the senses, then, and then only, should those experiences receive a name, which name—elasticity, for example—can be made no clearer by reference to a lexicon. Henceforth this word or symbol, whether thought, spoken or written, recalls the experience and takes its rightful place in the language of the child. Henceforth educational advancement is concerned with new experiences and their symbols, together with re-combinations, applications and rearrangements of the old ones, and this complex mental activity we designate as an enlargement of the boundary of mental vision. Again I assert that unless the child experiences, by the sense of sight or touch, the rebound of elasticity, as seen in rubber, glass or other substance, this quality of matter can never become a concept of his brain, and, consequently, it must remain as unknown to him as if it had no existence whatever. This real and individual contact with other objects is clearly implied in Dr. Porter's analysis of the knowing process: "To know always involves two comprehensive acts, each of which corresponds to the other—the act of separating or revolving objects as wholes into their parts, and the act of uniting or combining these parts into their wholes."

Concepts are founded upon percepts, but the former are rarely permanent, complete and triumphant. Perfect conceptions require experiences rendered perfect by varied, like and similar conditions. Such symbolic knowledge, saving us the necessity of returning to sensual experiences, supplies every want and answers every purpose which symbols can provide, and with these the future progress of the pupil is mainly concerned. These truths must be granted; then, have we not a clear necessity for emphasizing the duty of making the child's perceptions not only complete but systematic? Every primary school should be provided with abundant apparatus, for instance, the units of length, weight and capacity. With these the pupil should be allowed to make the measurements for himself, whereby he practically determines the gills and gallons, the inches and yards, the ounces and tons. Thus do the gills, inches and ounces, as perceived facts, become the gills, inches and ounces of truly conceived facts. "True perceptions form the basis of intellect."‡ It can not be too strongly insisted that personal experience is the sole requirement for personal acquisition, and this knowledge, at first intuitively gained, becomes knowledge symbolically known. Knowing the full force of these psychological truths, an eminent educator* has well said that "in regard to science, our schools are not above those of the Middle Ages—then, the students repeated the obscure statements of Aristotle, while now students repeat the statements of their text-books, without obtaining any valid ground for the conviction they are required to express." It is not difficult to compare some traits in the character of two individuals, one of whom has made science the usual literary study, as witnessed in most of the schools throughout the country, the other of whom has been drilled in the practical methods which a correct study of natural phenomena demands. The first

Has learned how useful are devices,
And gives all honor to inventors;
"Promptness," he terms a business virtue,
Historic, importance, he says, it hath not,
Ampère, he calls the mightiest intellect,
Familiarly quotes from works of Bacon.
Adroitly speaks of heed and caution,
Cites stunning things that have existed—
Whose nebulous causes are historic,
(Is sure he read it in the text-book).
Dilates upon the accidental,
Declares the causes supernatural.

The second

Clears the way with new devices;
Execution nerves his sinews,
Judgment, prompt and vigorous action
Make many blessings fly about him.

‡ The Art of Scientific Discovery.—GORE.

* Prof. Hinrichs, University of Iowa.

Anticipating, calculating,
(Has met neither Ampère nor Bacon,)
Returns, persistent, to the details,
Explaining all conflicting portions,
Feels not too strong in his conclusions.
Here, "accidentals" claim attention,
(Has heard not of the early Fathers).
"Investigate it!" is the watchword—
Demands to know the hidden causes.

In the domain of morals, the same principles obtain. There are two kinds of government—one exerted by the teacher, parent or society, the other by the individual who is to be restrained. The most perfect restraint is seen in individual control, where the fountain of discipline is in an enlightened judgment coupled with nobility of purpose. The most abominable restraint is the purely external one, as seen in the school-room only when the teacher is present, or in a domestic circle in which the proprieties of deportment are compulsory. Commonly, discipline at home, in the school and in society exists by a union of these two kinds of restraints. In Sicily, there is much of the external restraint—the arm of the civil and ecclesiastical power; in the United States, there is more of the "internal" restraint. The quality of society and the school varies with the proportions of these two kinds of restraints. Sad is the moral condition of that school governed largely by external influences, since, upon their withdrawal, the individual revels among his accidental changes of feeling and fancy without control. These truths render it possible to account for the bad order not infrequently seen at the lecture room, at church, and in most public gatherings. Thus is general lawlessness accounted for—defacing public property, indecencies of speech, and want in self-respect. Too little attention is given to the fundamental principles of true discipline, and too much to the mere education of intellect. There is no honor in graduating an intellectual rascal. It is of but little consequence to require a student to memorize and repeat, at stated times, sickly formulas of self-government, and to frequently remind him of duty to himself and his fellows. But the student must be assisted to govern himself at that moment when desire would entice him from the path of rectitude, at the instant when emotion wars against the weakened will. Mighty is the chasm which separates the languid, non-effective knowledge that we should do right, from the trained ability to be upright, when temptation's hour approaches. All know that we should not embezzle the property of another, but the virtue implied in this statement becomes effective and useful to the individual only after he has resisted temptation (of one kind or another) time and time again. The simple knowing that we should reason confers no ability to reason—the intellect must engage oft and deeply in the reasoning process, to acquire that ability; likewise, the simple knowing that we should do right confers no ability to do right—the moral powers must engage oft and deeply in those processes which constitute a moral act, before the mind acquires that desired ability. It is almost unnecessary to say that the simple learning of moral truths is an education of intellect and not a training of the moral powers of a human being. In the correlation of feeling and intellect, I am sure there is opportunity for research that will yield rich returns to an industrious explorer.

To return again to the intellect; an illustration: The eye falls upon a fruit-dish, and observations are made. After a lapse of a few minutes the word, "fruit-dish," suggests its peculiar form, its leaf designs, its fruit reliefs, its soft color, its position, its majolica material, its use, its grace and beauty and its slight defect. A week hence, its name suggests distinctly its form, its color less distinctly, and the details of its ornamentation with increasing faintness. A year hence, these scanty details have lapsed into no little obscurity, the name "fruit-dish" being as powerless to awaken original conceptions, in the fullness of their details, as Xenocrates' definition of soul: "A number moving itself." But what must be the significance of this term to a child who has even never observed one especially designed for the double purpose of ornament and for holding fruit? To strengthen this position, let me quote from an eminent educator, (Dr. Porter,) since teachers as well as other people rely more upon authority than upon their own common sense: "The impressions received from words, by one who has never witnessed the reality, are but as thin and pallid shadows, when contrasted with full and glowing intuitions." It must be admitted, then, that while the teacher's work remains among symbols, he handles a currency whose value is as shifting or changeable as the diversity of minds to which he appeals. These symbols form a redeemable currency, but not a currency that is oft redeemed. There is but one way for our educational systems to act in this matter, and that is to insist upon the evident necessity of the pupils first knowing the thing itself, then learning its name, followed up by a frequent reference of the symbol to the real object which that symbol represents. Only by this method can the increasing faintness of symbols be counteracted. Again, we teach by the use of symbols. Symbols of what? Symbols of former perceptions. Where have those experiences taken place? At the indulgent and perhaps wrangling home and upon the noisy, distracting street. Under what circumstances? By the merest accident and without careful examination; occurring among scenes of confusion or in moments of excitement; in hours of despondency, when emotion silenced the intellect; in a hap-hazard manner, when experiences are neither analyzed nor respectably put together and were forborne because unavoidable. Now, the question arises, "If the original experiences have been so imperfectly mastered, how can their symbols possess a high value? And if these symbols are the common currency of teacher and pupil who can longer wonder that the child's proggress is not only plodding but very discouraging? In view of these unrefuted facts, I fearlessly assert that no attempt at instruction is entitled to the name of system, or, is even tolerable, which does not provide for the systematizing and perfecting of experiences throughout the course of instruction. The corollary is sufficiently obvious; our schools must be provided with apparatus and specimens with which to reinforce the symbols, and, primarily, to furnish new experiences. Until those almost meaningless symbols, the sole possession of the average child at its entrance into the public school, have a freshness and force which, in our teaching we constantly assume, we may expect a continuance of the parrot work of the school-room and the difficulties of comprehension. Sensation, perception and symbolization, both in logical sequence and mental development, are the successive phases which constitute the Archean principles of mental development and human progress.

If the above be taken for granted, how can our partial success in the school room be accounted for? There is but one answer. This partial success is mathematically co-ordinated with, and is strictly dependent upon, those incomplete experiences which the child already possesses. Furthermore, those new forms of knowledge imparted to the pupil in the school room are comprehended by him, or as yet remain obscure, according as their elemental symbols are significant or meaningless. If the experiences whose symbols we divide, combine and variously use, are fresh by repetition or late in time, the new knowledge product will stand out in bold relief; but if—as is more commonly the case—the original intuitions were incomplete for any reason, the new knowledge-product will be unreal, unsatisfactory, and nebulous. It should be added here that although the the pupil may recite text-book statements in well rounded periods, it is still far from being a test that he understands what he so beautifully says. Thus do we reach the conclusion, by the consideration of a few points in mental growth that "object teaching" is the only rational method of primary instruction. By "object teaching," I mean teaching from the objects and the phenomena themselves by allowing the pupil to handle and otherwise examine these objects, and not from drawings, nor pictures, nor verbal descriptions, nor enchanting stories about them.

(*To be continued.*)

MEDICINE AND HYGIENE.

HEALTHFUL AND DANGEROUS OCCUPATIONS FOR WOMEN.

In the city of New York or surburbs we find women employed in staining and enameling glass; in making glass signs; in cutting ivory, pearl, and tortoise-shell; working in gutta-percha, gum-elastic, and hair; making willow-ware and cane chairs; feeding printers' presses and setting type; making and packing candles; molding tablets of water-colors; assisting in the manufacture of chemicals and fire-works; making clocks, enameling dials, and painting the cases; finishing backgammon boards; making and dressing dolls and toys; stitching the cloths and making the pockets of billiard tables; painting the handles of brooms, and weaving twine into netting; making paper collars and twine; burnishing jewelry and making buttons. There are about five hundred millinery houses in the city, employing over two thousand milliners, and the manufacture of straw hats engages several thousand women in weaving the braid, sewing, and bleaching. The artificial-flower trade employs about four thousand women, many of them French, and it is as lucrative to adept hands as any other. The manufacture of hoop-skirts is said to engage over ten thousand women, who spool the cotton, weave the tape and cover the steel; and the cap trade gives employment to many more thousands, whose earnings vary from three to five dollars a week. The weaving of hair cloth is also done by women, the packing of confectionery, and the making of shoe "uppers."

Some of these occupations, and others to which we have not referred, are dangerous to the operatives, not merely from the long hours of toil, the insufficient food, and the lack of proper ventilation in the workshops, but from the nature of the materials and the manner of fabrication. The artificial-flower makers, the gold-leaf workers, the button-gilders, the cigar makers, and the lucifer-match makers also suffer from the nature of their occupation.

In large manufactories of artificial flowers the ventilation is usually sufficient, and precautions are taken to prevent the inhalation of poisonous colors. But nearly all the brilliant leaves are made in the artisans' own home, a back room or an attic devoted to all the purposes of existence, and the arsenic that produces the spring-like vividness of color is diffused in the atmosphere and absorbed by the system. The fabric from which the leaves are cut is colored in the piece, Paris green, cold water, and starch or gum-arabic being used for the purpose. This liquid is spread by the fingers over lengths of fine calico or muslin, which are afterward beaten or kneaded by hand until they have an even tint. They are then spread out in frames to dry, and are next cut and shaded, the final process being their immersion in warm wax, and the removal of any loose color upon them. The detached particles float in the air, and are inevitably inhaled by the workers, whose handkerchiefs are speckled with dots of green blown out through the nose. Another operation, technically known as "grass-work," consists in the fastening of small glass beads or "dew-drop" to the artificial blades, which dislodges portions of the color, and leads to its inhalation. The consequences are variable. When the persons employed are cleanly in their habits, and keep their windows open, an occasional headache or an attack of dyspepsia is the most they suffer; but in other cases, all the symptoms of arsenical poisoning and revealed in eruptions of the skin, nausea, colic, and general debility.

In gilding metal buttons, mercury and nitric acid are used, producing their characteristic diseases; and in making lucifer-matches the work-women sometimes contract the terrible disease which is technically described as necrosis of the maxillary bones, many cases of which have been treated at Bellevue Hospital. In the preparation of gold-leaf the substance is so fragile and bouyant that the doors and windows are necessarily kept closed, and the air of the work-rooms becomes very impure. But the women who suffer most from the character of their occupation are the cigar-makers, who, mingling with men, boys, and children, toil many hours a day for five or six dollars a week, living in an atmosphere surcharged with dust and fumes that would make the most inveterate smoker sick. Part of the work is done in factories, but most of it is done in the dwellings of the operatives, and in neither is any attention paid to ventilation or cleanliness. Growing girls at the verge of womanhood suffer in many ways, and are as much under the influence of tobacco as a constant smoker. Their faces are pale, and their eyes are dead; a stupor comes over them; their nerves are unsettled, and their lungs are diseased in nearly every case.—*Harper's Magazine for June.*

"TAKING THE TASTE OUT."

Almost everybody knows that a globule of castor oil may be so folded by a deft and quick hand between two tea-spoonfuls of lemon juice that only the acid is recognized in the taking, and that where acids may not be used, the same effect may be secured by wine or spirit. But everyone does not know that any powerfully pungent substance, masticated for a moment and rejected, will prevent the necessity of acid or of spirit, neither of which, of course, it is always best to give. Thus, a bit of lemon peel or of orange peel, if chewed half a minute, will render castor oil as innocent as water, and it will do the same for the quite as vile taste of balsam copaiba. A little bitter almond, too, has the same power, if not more of it; and a peach kernel is not quite useless in that way. Indeed, one drop of the essential oil of almonds will neutralize the disgusting quality of a whole ounce of castor oil, we are told, without detracting from its virtues, and less than a tea-spoonful of the oil of orange will work the same magic on an ounce of balsam copaiba. If, however, not any of these articles is at hand, some strong peppermint is very effectual. Even licorice will prevent the taste of anything that is very bitter from being perceived, and, strange to say, is the only sweet substance known that is capable of doing that. A pinch of the leaves of sage, either dried or green, of pennyroyal, and even of catnip, if not quite so strong, is yet very efficient. Something as good as all the rest, although to the child probably not quite as agreeable, is the scattering of a few grains of Cayenne pepper on the tongue, after whose biting sting neither aloes, nor salts and senna, nor colchicum, nor thoroughwort, nor soda, nor bromide of ammonia, nor anything else, in fact, however disgusting otherwise, will make the slightest impression. If children, as it is very likely, should prefer the taste of the medicine pure and unadulterated to the smarting of the Cayenne, there are some grown people, and among them especially those gentlemen who, seldom needing to take medicine, make a great fuss about it when they do, and to whom Cayenne is so pleasant and necessary that some of them always carry it about them, may be glad to avail themselves of the knowledge in any case of need.—*Harper's Bazar.*

COMMERCIAL VALUE OF SANITARY WORK.

In a recent lecture in New Haven on the value of sanitary work, Professor Brewer, of Yale College, reviewed at great length the causes and effects of plagues and pestilences that did so much to darken the history of Europe during the Dark Ages. He then traced briefly the origin of sanitary science and its benefits, as shown in a largely diminished death rate. And after pointing out the four great obstacles to sanitation—ignorance, filthy habits, selfishness, and indifference—he proceeded to show how sickness, especially avoidable sickness, tends to impoverish communities as well as individuals. In this connection he said:

"Every student of history and of political economy notices the wonderfully rapid accumulation of wealth and capital in modern times compared with what it has been in previous ages. The material wealth and working capital of the civilized world has more than trebled in less than a lifetime. The accumulation of wealth and property (and it is this which represents the aggregate savings from labor) during the last few years more than equals all that had been saved in all the thousands of years that had gone before, and that, too, while there has been a more general enjoyment of the comforts of life and a much greater indulgence in its luxuries. The nature and sources of this rapid growth have been the subject of much discussion by the statesmen and political economists. The causes generally assigned are the invention of modern machinery, the use of steam as a motor, the growth of modern means of transportation by sea and land, the application of the natural sciences to the arts and industries, the spread of popular education, the diminution of wars, and the production of the precious metals. There is no doubt that each and all of these have had their influence; but there is one still greater cause which is too often overlooked, simply because it is not so conspicuous. The greatest of all causes is to be found in the better average health of civilized countries, and the longer average term of life which is now secured to workingmen.

"It was not merely war, nor because they did not have steam, nor did not know about greenbacks, that kept the masses in poverty all through the Middle Ages—it was disease, and the death that came from disease that kept the nations poor. The history of the Middle Ages is a sad succession of plagues, of cities devastated, of States impoverished, of laborers swept away in millions, by successive waves of pestilence that followed each other as often as cities grew populous. Between the common sickness which was ever present and the pestilences which swept off their millions at a swoop, the average period available for actual labor in man was perhaps not more than half what it is now. Meanwhile, it took just as long to rear children to a working age as now, and sickness was just as expensive; so, between the diminished power of production, the waste by sickness, the panics and checks to commerce caused by plagues which were raging somewhere all the time, it is no wonder that wealthy people were comparatively few and the masses sunk in abject poverty. If we are tempted to think that we are saved from this by steam or machinery or increased production of the precious metals, let us look at any pestilence-stricken city of modern times. A single pestilence of but a few months came near bankrupting Savannah, and laid a check on her progress and a burden on her resources which it will take many long years to overcome. Worse still is the case of Memphis, with its two pestilences; and such may be the loss to any American city if it neglects sanitary laws. Our modern civilization is one of intense competition. Each producing community is now in a struggle with all the rest of the world as it never was before. If it have any special advantage, it may prosper; if it have any special disadvantage, it either lags behind in the swift race, or, by standing still, relatively declines, or else it goes under in the hard struggle of productive or commercial competition. And what heavier burden to bear than sickness! And yet this fact is liable to be overlooked or forgotten. The healthy man hopes that sickness will never come, and may be careless of his health, and the healthy community rarely awakens to danger until epidemic sickness sets in, and the loss is actually begun.

"It is the part of sanitary science to point out the dangers and suggest means of prevention, and when epidemics actually set in to suggest remedies; it is the part of sanitary legislation to provide means to apply these remedies; it is the function of health boards to administer them. But, from the nature of the of the case, the better they do their work the less obvious are their labors. The officer who heroically stands at his post during the time of pestilence, labors to stay its dread work, helps the suffering, and comforts the dying is a hero, and the heroism is of a kind that can be seen; no praise is too high. But the other officer who, by his labors, prevents the pestilence and keeps it so far off that the danger is scarcely seen, receives no such praise—too often in its stead criticism, opposition and indifference. It is because of the nature of sanitary work that its value in increasing the prosperity of a city is so often overlooked. In the ordinary pursuits of business, the clang of machinery, the brilliancy of the applications of science to the arts, the bustle of business, the romantic ways in which the precious metals have been discovered and won, are more conspicuously in the eyes of the public than the quiet, persistent, unromantic, but heroic fight with unseen but unwholesome influences which lurk in the air of our towns. These malicious influences, mostly growing out of our modes of life, are ever present in all our cities, ever growing unless checked, always producing disease, and from time to time especially inviting pestilence, as persistent as sin, as tireless as nature, and as pitiless as death. The rapid growth of town and city populations, as compared with the country during the last forty or fifty years has been made possible only by the power which modern sanitary science gives us to prevent, to check, and to combat epidemics. As matters were before, a pestilence of but a few weeks or months would put back the growth of a city for years. This city has had but one visitation of yellow fever; it lasted scarcely two months, and, from all I can ascertain by a careful investigation of the matter, it took from eight to ten years to recover from the shock. Indeed, can we say that it ever recovered? What New Haven might have been, had it not been for that check, just at a time of rapidly growing commercial importance, we can never know, but that citizens left, with their capital, to go into business elsewhere, and never came back, and that trade left the place and never returned, is certain. What 'might have been' had this pestilence not fallen on us eighty-six years ago we can never know. What may be, if another pestilence comes, we know too well. Too many cities have had such a bitter experience, even in modern times, for us to be ignorant of the effects.

"We insure our manufactories from loss by fire to insure their being rebuilt if once burned. Even with this, the temporary suspension of work may drive trade elsewhere. Hence premiums are cheerfully paid to guard against the possible contingency, and before the conflagration comes we cheerfully purchase fire-engines and apparatus, and organize bodies of skilled men to use them when the emergency comes. Here it is recognized that all this, though expensive in the beginning, is cheap in the end, and yet how reluctantly any such means are taken to guard against a worse destroyer of our wealth and prosperity. The arguments used even by official bodies against adequate support of public health administration in many, if not most cities, are curiosities of inconsistency, and will be cited as such by the next generation. It must not be forgotten that health boards are now more strongly demanded and called for because of their pecuniary importance than because of their function in allaying human suffering or saving human life. So long as merely men died, and health was lost, and sorrow fell on thousands of homes, Memphis went on as of old, dug her cesspools deeper and more of them, and did without sewers, but when the loud voice of trade cried out, 'We can not afford to allow Memphis to longer stand as a menace to the commercial prosperity of the great Mississippi valley,' then, and not till then was a system of sewering begun. A high death rate means loosened vigor, lessened powers of production, a check on prosperity, a burden on industry. A low death rate in modern cities can only be secured by public sanitation, and by an intelligent and efficient co-operation of the public with an active board of health. A single epidemic but one-fourth as bad as that in Memphis last year would cost this city more, and leave us with higher taxes, that the most expensive system of sewers and of garbage collection than was ever dreamed of here. And there is nothing to prevent it but public sanitation. We had that very disease here once, and the city did not recover its prosperity for ten years, and it lost some phases of prestige which it never regained. An epidemic of small-pox a few years since lost to the city of Philadelphia, in ways which could be estimated, above $20,000,000. This city a little later was seriously threatened with a similar epidemic, which was effectually stayed, and the health officers were, perhaps, more severely criticised for their work than for any other thing they have ever done. The results, however, have amply demonstated the wisdom of their action.

"The fact wants to be kept before the public, that as production and commerce and trade are now carried on, few cities can afford to allow a pestilence to invade them. And if it comes to a city, with the natural advantages of soil and climate we have, it is due either to official ignorance or public neglect. There is, perhaps, not a single kind of pestilence which has afflicted any civilized city of temperate climate during the Dark Ages or since, over which we have not now control, if the community act up to the light and knowledge we have; and on the other hand, as business is now carried on, no city can now be afflicted as many then were, and not be bankrupted and financially ruined.—*Scientific American Sup.*

FOR DIPHTHERIA.

A physician in Illinois writes: I have used successfully the following for some years for diphtheria: ℞ sulphite soda gr. x., dissolved in ℥i. warm water. Then add ten gr. salicylic acid. Dose, teaspoonful every fifteen to thirty minutes (or oftener) to a child of two years. At the same time use beef tea, wine, eggs, quinine, etc. I find this an effective anti-zymotic. In bad cases it must be used for some days.

CHLOROFORM VAPOR IN EARACHE.—At a recent meeting of the Medical Society in the District of Columbia, Dr. James E. Morgan stated, during a discussion on otitis, that he had often promptly relieved the distressing earache of children by filling the bowl of a common new clay pipe with cottonwool, upon which he dropped a few drops of chloroform, and inserting the stem carefully into the external canal, and adjusting his lips over the bowl, blew through the pipe,—forcing the chloroform vapor upon the tympanum. Dr. J. Ford Thompson has also accomplished the same relief upon similar principles.

GEOGRAPHICAL NOTES.

THE HOWGATE EXPEDITION.

The vessel selected and furnished for this expedition is a Clyde built iron frame propeller, 200 tons burden, 140 feet in length, 21 feet 6 inches breadth. The engine has two 30-inch cylinders, each 24 inches stroke, jet condensers, and one boiler. The engine is estimated to be of about 200-horse power. The works have been overhauled and put in complete order by Petitt & Dripps, machinists, Washington, D. C.

It has been greatly strengthened by filling in 2½ inches oaken plank between the iron frames, sheathing inside and outside with stout oaken planks, so as to make the hull uniformly 15 inches thick. To guard effectually against the nip or pinch of the ice, which sometimes crushes in the sides of a vessel as easily as an egg shell, the inside of the hull has been braced with extra heavy white oak timbers placed horizontally, and from side to side in the various compartments of the ship, directly on the water line. Inside the prow three heavy white oak breast hooks have been placed, and on the outside of the bow, over all, is a sheathing ⅜ of an inch iron armor, extending 10 feet deep and 14 feet aft from the stern.

Capt. H. C. Chester, formerly of the Polaris expedition, who is an experienced and intelligent Arctic explorer, has superintendence of the work of fitting the Gulnare for service in frozen seas. He has placed on the sides of the vessel extending above the water line, wedge-shaped oak timbers, which are calculated to ease the vessel upward when pressed by heavy ice. This is an idea resulting from the experience of the Polaris, which, when caught in the pinch of the ice, was forced downward and crushed. A new main deck has been put on, the planks being bolted to the iron frame of the ship, and secured on the inside by nuts screwed to the bolts. A new smoke-stack and an extra propeller have been provided, and amidships will be placed a new bridge 21 feet long.

As the Gulnare will be used primarily to found an arctic colony of observers, to be recruited by other explorers hereafter, one of the chief designs in preparing the vessel for service has been to secure all the storage room possible for provisions, materials, instruments, arms and munitions. On the deck will be carried the frame work and other parts of a complete house sixty feet long by twenty feet wide, built on the plan of the houses so long employed by the Hudson Bay Company. This house has been put up temporarily in Washington on the vacant lot on Fourteenth street, near New York avenue. It is a complete double frame house, with 12 or 14 inches space between, so as to afford the protection of an inner wall of caloric. All the pieces are marked and numbered, and when taken apart may be stowed in a small space, and afterward put together readily by the arctic colonists. Window frames and glass to give light, stoves for heating, lamps and other necessaries will be carried sufficient for a company of men at the polar station, as well as for the ship's company on the voyage.

In the forward part of the Gulnare is the forecastle, or berth deck for the seamen. There are accommodations for twenty-five men in this part of the ship, but the quarters will be very close. Under the berth deck is a fresh-water tank and storage room. Between this compartment and the coal bunkers, near the engine, the hold is entirely given up for storing supplies. The engine, boiler and coal of course occupy the center of the ship. Aft of these is the cabin, which is a neat and cosy little apartment, with state-rooms on each side, with accommodations for 18 officers and scientists. In the hold beneath the cabin is room for storage. When completely fitted out the little vessel will be closely packed with material and subsistence stores, and it is expected her complement of officers and crew will aggregate upward of 40 souls.

In addition to steam power the Gulnare carries main and foremasts, which have been put in new, with new spars, cordage, etc. The rigger is J. W. Willams, 106 Thames street, Baltimore. Pollard & Padgett, sailmakers, Alexandria, Va., have made duplicate sets of new sails entire. The vessel is square-rigged forward, square foresail, topsail and gallantsail, lug 4½ foresail; the main is schooner-rigged and gaff topsail. No pains or expenditure has been spared to insure the best outfit and the most serviceable material.

The station to be established in the Arctic region will be on the north side of Lady Franklin bay, in 81° north latitude, near a coal deposit found by Nares' expedition. The landing party will be in charge of an officer of the United States Army. The expedition will be commanded by United States navy officers, and the crew will be selected also from this branch of the public service. Capt. Howgate, whose idea is being put in practice, will remain here at the base of supply to look after the sinews of war and to direct operations in the advance on the heretofore sealed region of the north pole, which will be made with a steady and systematic persistency which must win in the end, and finally gain for our countrymen the renown of having overcome the frozen barriers with which nature has hemmed in this interesting and forbidden region.

When the men and material which the Gulnare now carries out have been landed and their house has been put up and supplied this summer, the steamer will return to the temperate zone for more supplies and men to replace those who may have become disheartened or disabled. From the colony first planted, expeditions will be sent out and a series of continuous advances made by planting camps further and further northward, until at last the main object is attained. But the glory of reaching the north pole over all obstacles, and over all other peoples who have striven for many years in this fascinating adventure, is not alone the object of the Howgate expedition. There are other and higher aims in the interests of science and knowledge, the fruition of which will be developed in the future of that intelligent corps of public servants, whose ceaseless watch and scientific industry already enable us to protect some of the most important pursuits in life, as well as the individual health and comforts. While the struggle to advance further over the frozen steppes and icebergs of the north will never cease, the time consumed will not be lost otherwise. Each day will have its duties peculiar to the region, in the fight to live as well as in the observation and recording of natural phenomena, and in practical siege of the north pole, which is to be instituted in this system of steady and gradual approaches.—*Baltimore Sun.*

ARCTIC RELIEF.

The following instructions to the commander of the Revenue Cutter Corwin, explain themselves:

TREASURY DEPARTMENT,
OFFICE OF THE SECRETARY,
WASHINGTON, D. C., May 15, 1880.

Captain C. L. Hooper, Commanding Revenue Steamer Corwin, San Francisco, Cal.:

SIR—The department having determined to dispatch the revenue steamer Corwin, under your command, to cruise in the waters of Alaska for the enforcement of the provisions of law and protection of the interests of the government on the seal islands and sea otter hunting grounds and of Alaska generally, you are directed to take on board that vessel, without delay, supplies of provisions for a six months' cruise and sufficient quantities of fuel and water and leave San Francisco with your command not later than the 22d inst., for the waters named and make the best of your way to the places hereinafter designated.

It is desirable that you should be in Behring Sea and the Arctic Ocean as early in the season as the opening of navigation will permit. You will accordingly proceed from San Francisco direct to Ounalaska, and on arrival there will take in a fresh supply of coal. From this point you will proceed to Norton Sound, touching at the seal islands on your way. You will leave an officer and two men on Otter Island for the purpose of protecting the seals there, unless you should deem it necessary to take all your command with you in your further cruise to the northward.

It is expected that you will time the movements of your vessel so as to arrive in Norton Sound before Behring Strait is open for the passage of vessels, and that you will avail yourself of the first opportunity to push into the Arctic Ocean. Arrangements have been made by which the Alaska Commercial Company will place about fifty tons of coal at a convenient point on this sound, from which you may replenish your supply, if found necessary, at any time during the season.

By reference to the report of Captain George W. Bailey, United States Revenue Marine, who commanded the revenue steamer Rush, in her cruise last year in Alaska waters, you will observe that Kotzebue Sound, in the Arctic Ocean, is reported as the rendezvous of a number of vessels engaged in illicit traffic with the natives of Alaska in rum and fire-arms. You will use your utmost endeavor to apprehend any such vessels as you may find thus engaged and break up their illegal trade.

It has been reported that two whaling barks, the Mount Wollaston and Vigilant, were probably caught in the ice within the Arctic Ocean last Autumn while endeavoring to return through Behring Strait from their season's whaling, and fears are entertained for their safety. You will make diligent search for said vessels, and should you fall in with either of them or with any of their officers or crews, you will afford such succor or assistance within your power as may be required. Should any persons desire to send contributions of provisions, etc., for the relief of those whalers, you will receive the same and dispose of them in such manner as circumstances may require.

You are further instructed while in the Arctic to make careful inquiries regarding the progress and whereabouts of the steamer Jeannette, engaged in making explorations under the command of Lieutenant Commander De Long, United States Navy, and you will, if practicable, communicate with and extend any needed assistance to that vessel.

Should you be able to accomplish your mission in the Arctic Ocean early in the season, or find it necessary in carrying out these instructions to return to the seal islands before the usual time (say October 10) for the return of the revenue steamer from those waters, you will make a cruise to the westward from Ounalaska as far as Atton, with the general object of protecting the seal otter hunting grounds and breaking up the business of illicit traders who frequent those waters. You are, however, permitted in your discretion to remain in the Arctic Ocean as late in the season as may be necessary to accomplish the object of your voyage without encountering undue hazard to your command.

A rumor of the wholesale starvation of the inhabitants of St. Lawrence Island, in Behring Sea, is noticed by Captain Bailey in his report of last year. You will investigate the facts regarding the matter if opportunity offers, and will, if practicable, land upon that island and ascertain the number and real condition of said people.

While cruising in the Arctic Sea you will make careful observations as to currents, tides, etc., and will keep an accurate record of such soundings, surveys, etc., as you may be able to make, and you will obtain such information as may be practicable regarding the numbers, character, occupations and general condition of the inhabitants of the adjacent coasts.

Previous to sailing from San Francisco you will forward to the department a muster and descriptive roll of the officers and men of your command.

You will whenever opportunity presents transmit to the department reports of the progress of your cruise.

In conclusion, the department, having defined the general objects of your voyage and relying upon your skill and good judgment, confides to your discretion the details of your cruising within the Arctic Ocean, and takes pleasure in wishing you a prosperous voyage and a safe return. Very respectfully,

JOHN SHERMAN, Secretary.

AWARD OF THE ROYAL MEDALS OF THIS YEAR.

The Royal medals or premiums intrusted to the Society by the Crown "for the encouragement and promotion of geographical science and discovery," have this year been awarded as follows:

The Founder's (King William IV.) medal, to Lieut. A. Louis Palander, in recognition of the services rendered by him to geography, as commander of the Vega in the late Swedish Arctic expedition, during which he safely navigated the vessel along the unsurveyed shore of the Asiatic continent for nearly 3,000 miles. The Patron's, or Victoria medal, to Mr Ernest Gills, for leading four great expeditions through the interior of Western Australia in the years 1872–6, during which 6,000 miles of routes were surveyed, and 20,000 square miles of new country discovered.

PUBLIC SCHOOL PRIZE MEDALS.

The medals for geographical proficiency annually offered by the Royal Geographical Society to the leading public schools have this year been awarded as follows:

Physical geography gold medal, to David Bowie (Dulwich College). Silver medal to Albert Lewis Humphries (Liverpool College). Honorably Mentioned, G. I. Schorstein (City of London School,) S. Edkins, (City of London School), P. J. Hartey, (University College School), H. McMasters (Liverpool College), R. G. Reid, (Dulwich College).

Political geography, gold medal, Frederick James Naylor (Dulwich College). Silver medal, Theodore Brooks, (London International College). Honorably Mentioned, C. F. Knaus, (Dulwich College), C. E. Mallett, (Harrow School), W. H. D. Boyle (Eaton College), A. D. Rigby (Liverpool College), M. G. Grant (Liverpool College), C. J. Casher (Brighton College). The special subject this year was Western Africa, between the Sahara, the territory of Egypt, and the 6th parallel of south latitude. The examiners were, for Physical Geography, Commander V. L. Cameron, R. N.; for Political Geography, Admiral Sir Erasmus Ommanney, C. B., F. R. S. The examinations were held on the 15th of March.

ITALIAN EXPLORERS IN AFRICA.

Dr. P. Matteucci, who has not long returned from Abyssinia, has already, as we learn from Cora's 'Casinos,' started on a third expedition into Africa, with the object of exploring the little known State of Wadai, our present knowledge of which depends almost wholly on the information collected by Dr. Nachtigal. Dr. Matteucci is accompanied by Don Giovanni Borghese, son of Prince Borghese, at whose cost mainly the expedition has been fitted out, and Lieutenant A. Massari, as scientific coadjutors The travelers visited Cairo in February last and were furnished with copies of the surveys executed by Egyptian staff officers in Darfur, and on the part of the Khedive with letters of recommendation to the Sultan of Wadai. The routes to be taken by the expedition is via Suakin, Berber, and Kharturn; and they started from Sully on the 24th of

February last. Respecting the fate of the travelers Chiarini and Cecchi, who left the kingdom of Shoa, two years ago with the intention of proceeding through Kaffa to the African equatorial lake region, the Italian authorities are still in some uncertainty. The last intelligence respecting them was to the effect that they had both reached the town of Kaffa in February, 1879 in good health, had been well received by the king, and were on the point of continuing their journey to the lakes. Since then no further news has been received, and considerable uneasiness prevails, owing to the hostile attitude of the Mohammedans in those parts.

MISCELLANEOUS.

MAKING AND PRESERVING LAWNS.

BY WALTER ELDER.

To properly make a lasting lawn, and keep it in good order, taxes the highest skill of the horticulturist, and when well executed, is the masterpiece of ornamental gardening. Without it all other improvements look insignificant. It forms the green carpet upon which all ornaments are to be placed, and its bright verdant hue imparts beauty to all.

Instructors upon lawn making, generally advise subsoiling the ground. If this be done, it should be a year previous to laying down the lawn. It is not always best to do it, as the subsoil may be a stiff clay, or barren sand. I have seen subsoil brought to the surface so poor that not even beans, peas or corn would grow—the germs rusting and decaying away. The seeds of grasses are small and succeed best in mellow and fertile soil. Several species of grasses should be sown, and very thickly, to make a close, green turf. Red top or herd grass, blue grass, orchard grass and a little white Dutch clover. The land should be manured the the previous year to sowing the grasses. After digging or plowing, harrow or rake fine, level up all hollows, and roll firmly down. Then sow the grasses, rake fine or harrow, then roll again. The sowing time will be according to climate and latitude. Between New York and Baltimore, say from early March to middle of May, and from early September to early in October, and all the Fall after that. When grasses and weeds are well up, roll well, and let them all grow until the earliest weeds shoot up flower stalks, then mow down with the scythe or horse-mower, and scatter the cuttings evenly over the surface. When they wither, roll again, and then rake all off. On sandy lands the summer mowings should be seldom. On sloping lands and terraces or banks, the grass should be let grow long in hot, dry weather, unless artificial watering is at hand. The lawn should not be weeded the first year, but cut down all weeds when they bloom to prevent them bearing seeds. Weeds may be all taken out in late fall, and more grass seeds sown. Men with table knives can get out a vast number of weeds in a short time. A thorough digging out of weeds, with table knives, will keep the lawn nearly clean. Do it in late fall or early spring. The lawn should be firmly rolled down every spring. It is good to sow some more grass seeds in late fall or early spring, so as to insure a close turf the next summer.

Barnyard manure, so fermented and rotted as to kill all seeds of weeds in it, is the best fertilizer. It should be spread equally over the surface in fall or winter, as it is a most excellent fertilizer, when applied at the rate of five to ten bushels to the acre. Marl mixed with plaster of Paris is beneficial on sandy lands. Guano, and all the concentrated fertilizers are good, but their effects are different upon different lands. Lime, wood ashes and stone coal ashes should all be compounded with soil a year before using, and spread over the lawn in the fall.—*Gardener's Monthly.*

BALM OF GILEAD.

Dr. De Hass gives the following particulars as to this far-famed specific for all diseases: The name of Gilead was sometimes applied to all trans-Jordanic Palestine; properly, however, it included only the country east of the Jordan from the head of the Dead Sea to the foot of the Lake Genesareth, of which Mizpeh Gilead was the crowning point. It was here, along the Jordan and about Jericho, the balsam or balm once so highly prized, was procured from an aromatic tree, supposed still to be found in this region, and known as Spina Christi, or tree from which the Savior's crown of thorns was woven. This most precious gum was obtained by making an incision in the bark of the tree; it also oozed from the leaves, and sometimes hung in drops like honey from the branches. The tree which originally was found in Palestine, was transplanted to Egypt by Cleopatra, to whom the groves near Jericho were presented by Mark Antony. The shrub was afterward taken to Arabia and grown in the neihgborhood of Mecca, whence the balsam is now exported to Europe and America, not as balm from Gilead, but balsam from Mecca. The gardens around Heliopolis and the "Fountain of the Sun," in Egypt, no longer produce this rare plant, and it has long since ceased to be an article of export from the ancient Gilead.—*Journal of Chemistry.*

SEEING BY ELECTRICITY.

As regards the general question of seeing by electricity, the principles involved are somewhat different from those which have entered into other electro-telegraphic problems; the element of *time*, which plays such an important part in all telegraphic inventions hitherto brought out, is almost wholly absent when the question of sight is involved. In the transmission of sound, or of telegraphic signals by electrictlty, we have to cause a succession of signals to follow one after the other, and hence it follows that a single telegraphic wire is able to effect all that is required. In the case of *seeing*, in order to enable the form and color of an object to be rendered evident to the senses, it is necessary that a series of impressions, infinite in variety, be produced upon the retina in almost immeasurably short space of time, and, practically, all at the same instant; we must have, in fact, an infinite series of waves transmitted at the same, or nearly the same moment. To do this through a single wire by electrical means is a difficult problem; but that it will eventually be done by means of a single wire, is, we think, an undoubted fact. How it is to be done is another question; but we feel certain that no arrangement involving a multiplicity of wires will ever enable success in the direction aimed at to be attained. It is not because a multiplicity of wires is objectionable for practical telegraphic purposes that we say this; but, because, almost without exception, all complete solutions of problems, like that of the telephone, for example, have been most completely and thoroughly effected by the simplest means.—*Telegraphic Journal.*

THE RELATION BETWEEN INSECTS, PLANTS AND MAMMALS.

BY LESTER F. WARD, A. M., WASHINGTON, D. C.

It is a fact of profound significance that the higher flowering plants made their first appearance on the globe simultaneously with the *Hymenoptera* and *Diptera* in the Jurassic and Cretaceous formations, while they did not reach their highest perfection until the *Lepidoptera* had appeared in the early Tertiary. The *Neuroptera* and *Orthoptera* which are found in the Carboniferous could have contributed nothing to the demand for cross-fertilization, and the *Coleoptera*, sparingly met with below the Trias, were doubtless then equally ineffectual in this respect; as even at present they only supplement to a slight degree the work of the bees, flies, moths and butterflies. And we accordingly find that the vegetation prior to the Jurassic and Cretaceous epochs consisted almost wholly of Cryptogams and Gymnosperms, with only a few amentaceous and monochlamydeous Angiosperms in the highest of these strata.

These facts justify the assumption that most of the higher flowering plants would speedily perish were insect aid withdrawn, and also that but for such aid in the past we should now see, instead of our gorgeous flora of Orchids, Lilies, Magnolias, and Roses, one consisting chiefly of Ferns. Cycads, and Conifers, mingled with willows, oak, and alders, and plain grasses and rushes.

But when we consider how poorly adapted Cryptogamous and Coniferous vegetation is to the support of animal life, we may also declare with perhaps equal certainty, that but for the *Phænogamia* there could have been no *Mammalia*. A picture that should represent herds of buffaloes and antelopes roaming amid the Ferns, Lepidophytes, and Calamites of the Carboniferous epoch would be an anachronism whose realization it would be impossible to conceive. And thus we have, only on a grand scale, one of those singular chains of cause and effect of which naturalists have pointed out several (that of the dependence of clover upon cats, being perhaps the most familiar), but which, apart from that grotesqueness which they sometimes possess on a superficial view, are among the best illustrations of that intimate and far-reaching *consensus* which prevades all departments of life.

Considering to what extent man is dependent upon the *Palmaceæ*, *Rosaceæ*, and other fruit and nut-bearing trees and plants, which, at least on the theory of man's simian origin, must have been far greater if not absolute in the early period of his existence; considering, too, in connection with this, that it is the *Hymenoptera* that have contributed most to render the existence of this class of vegetation possible, it ceases to be a mere poetic fancy to claim for the bee and the ant the high merit of having literally prepared the way for the advent of man, whose prototype they are to so great an extent, both in their psychic and their social attributes. * * * * * * —*American Entomologist.*

MAY JEWS EAT OYSTERS?

A certain elder of the Hebrew Church in America recently propounded the doctrine that oysters are "plants," and are not, therefore, included among any of the articles prohibited as food under the Mosaic law. He probably based his remarkable discovery on the difficulty which modern research has thrown in the way of accurately determining the line which divides animals from plants. Some of the members of his church appear to accept the doctrine, and have become habitual eaters of oysters; while others maintain that these bivalves are "unclean," and avoid them accordingly. A question of extraordinary delicacy is thus opened up. The different views on the subject of those who do not accept the "plant" theory, may be expressed in the following manner. Among the various "unclean" animals enumerated in the Levitical law, those creatures of the water "that have neither fins nor scales," are specifically mentioned, and it may be argued that oysters do not come within this category, for do we not speak of green-finned oysters? and are not the shells virtually "scales"? On the other hand snails are specifically forbidden, and it is claimed that oysters are really snails? but then snails might be said to be covered by the prohibition of "creeping things," and those that "go upon the belly," so that the mention of snails ought not to be taken as including more than those particular creatures.

Altogether the problem is as delicate as it is curious and interesting. It ought, however, to be met fairly, and settled authoritively. To call an oyster a "plant," for the purpose of evading the generally accepted rendering of the Mosaic law is begging the question altogether.—*The Caterer.*

RECENT TELEPHONE EXPERIMENTS.

At the suggestion of one of the proprietors of this Journal—Mr. A. E. Beach—a series of interesting experiments relating to the electrical transmission of sounds has lately been commenced in this vicinity, which seems likely to lead to a variety of useful results. In the introductory experiment the *Scientific American* office and Mr. Beach's dwelling, in the upper part of this city, were connected by wire with the auditorium of Plymouth Church—Rev. Henry Ward Beecher's—in Brooklyn, N. Y., and these points were also telegraphically joined by the wires of the Bell Telephone Company and those of the Gold Stock Company, the electrical circuit being thus enlarged and ramified in all directions, communicating with offices and dwellings in New York, Brooklyn, Jersey City, Newark, Orange, Elizabeth, Yonkers, and other adjacent places. One object of the experiment was to determine approximately through how many united circuits and lines the voice of a public speaker might be simultaneously transmitted.

At Plymouth Church, in Brooklyn, the wire passed under the floor to the platform or pulpit, where it connected with two of the well known Blake transmitters arranged upon a shelf under the speaker's desk. The general arrangements for the experiments were under the charge of Mr. Fredrick C. Beach, Ph. B., of the *Scientific American* office.

When it became known at the Bell telephone office in Brooklyn that experiments were to be tried, the interesting news soon spread to all other telephone offices, and the various operators not only called into their offices parties of their friends to enjoy the treat, but gave notice to numbers of private persons having communicating wires, who in turn invited friends to their dwellings. Thus at many points on the great ramification of connecting wires were groups of persons waiting, with telephones at their ears, to hear the words of the distinguished speaker. At one of the stations fifteen telephones were in this way connected, the instruments being joined by wires, just as a circle of people join hands in sharing an electrical shock.

The first experiment was made on Sunday, April 18, and was on the whole perhaps more successful than could have been expected. The telephone listeners stationed in Brooklyn, and nearest the church, were enabled to hear the service with much satisfaction; but those in New York, Yonkers, and Orange, N. J., only heard the music and portions of Mr. Beecher's sermon. It was concluded on the whole that there were too many telephones in circuit; and it was subsequently ascertained that the wire leading to the church had been surreptitiously tapped where it passed over a dwelling, a ground made on the tin-roof, and a considerable number of telephones smuggled in.

On the following Sunday, April 25, another trial was had, precautions having been taken not to allow so many tapping lines or instruments in circuit. Special care was also taken by Mr. Adee, the adjuster of the Bell Telephone

Company, to give the most delicate adjustment to the transmitting instruments at the church. The result was most successful and marvelous.

From the opening note of the organ prelude to the last word of the preacher's voice, at the close of the service, everything was delivered to the ears of the listening telephoners in the most perfect manner, the tones that came over the wires being so full, round, and clear, and distinct, it almost seemed to the hearers in New York, Yonkers and Elizabeth as if they were stationed within the church itself directly in front of the speaker.

The delivery of the music was equally perfect, every note of the organ and of the individuals of the choir being fully brought out. The majority of the participators in this experiment were persons accustomed to the use of the telephone, and their unanimous verdict was that the results obtained far surpassed anythlng of the kind within their previous experience.

These experiments proving successful, several new improvements have been suggested for trial, and there seems to be every probability that in a short time some new and very effective instruments will be in use, by which all who desire may carry the sounds of church services into their dwellings, and may also enjoy the best lectures, musical and other entertainments with the utmost satisfaction in their homes. Heretofore, in listening to the telephone, it has required effort and strain of the ear on the part of the listener. But this experiment shows that all sounds may be delivered in full and easy tones, readily heard, with all the natural characteristics, modulations, and inflections of the human voice.—*Scientific American.*

BLACK INK FOR STENCILS.

The following is commended for the preparation of a black ink or paste for use with stencils: Bone black 1 pound, molasses 8 ounces, sulphuric acid 4 ounces, dextrine 2 ounces, water sufficient. Mix the acid with about two ounces of water, and add it to the other ingredients previously mixed together. When the effervescence has subsided, enough water is to be added to form a paste of convenient consistence.

BOOK NOTICES.

WATER ANALYSIS FOR SANITARY PURPOSES. By E. Frankland, Ph. D., D. C. L., F. R. S. Philadelphia, Presley Blakiston, pp. 149. $1.

In view of the rapidly increasing population of our cities, and the corresponding increase of the contaminating materials, formed in factories, chemical works and households, which flow into our streams or filter through the soil into our springs and wells, it is of the utmost importance that the people should be informed how they can test their drinking water for unwholesome ingredients. This is the object of Dr. Frankland's little work, which, while strictly scientific and technical, is at the same time written in such a style as to be readily understood by ordinary readers. Part I, is devoted to water analysis without gas apparatus, including the preliminary examination of samples, solid matter in solution, ammonia, chlorine, hardness, nitrogen, poisonous metals, organic impurities, etc. Part II, is devoted to water analysis requiring gas apparatus, including the determination of carbon and nitrogen in organic matter by the combustion process, the eudiometrical determinations, interpretation of the results of combustion, sewage or animal contamination. The appendix (40 pages) contains lists of reagents, tables, typical analyses, etc., closing with the conclusions and recommendations of the Rivers Pollution Commissioners of England.

Physicians, sanitary commissioners and boards of health will find it a "handy volume" in their work.

MISSOURI UNIVERSITY LECTURES. By Members of the Faculty, 1878–9; Course II, Vol. I, pp. 504. Statesman print, Columbia, Mo.

In 1877–8, the Faculty of the Missouri University inaugurated the delivering of a series of lectures illustrative of the various special departments, which was found to be a decidedly popular move. During the past winter a second course was delivered with similar favorable reception by both students and the public, to whom they were made free. They were afterward brought together and published in a neat volume for general distribution.

The table of contents is as follows: Petroleum, by Prof. Schweitzer; Evolution and Creation, by Prof. Swallow; Insect Ways, Prof. Tracy; Mathematics, Prof. Ficklin; Three Pronunciations of Latin, Prof. Fisher; Mosaic Cosmogony, Prof. Meyrowitz; Linguistic Curiosities, Prof. McAnally; Arnold of Rugby, Prof. Bibb; The Professional school, Prof. Lowry, The Ideal of Art, Prof. Bingham; Metaphysics, Prest. Laws; Advantages of Classical Study, Prof. Fleet; Study of Language, Prof. Blackwell; Art, Prof. Diehl.

Some of these have been published in the REVIEW, others have been quoted from or commented upon; all are excellent and the work is worthy of the wide circulation that it has received.

DWELLING HOUSES. Their Sanitary Construction and Arrangement. By Prof. W. H. Corfield, M. A., M. D. (Oxon.) D. Van Nostrand, New York. 18 mo. pp. 156, 50 cents.

This is Number 50 of Van Nostrand's Science Series, reprinted from Van Nostrand's Engineering Magazine, and is a very valuable, practical essay, by a distinguished architect and professor of the University College, London, upon a subject of absorbing interest to all classes of society.

Situation and construction of houses from foundation to roof, including drainage, ventilation, heating and all other points, are fully considered and discussed from a scientific and common sense standpoint, and the little volume presents a competent guide to the builder and owner of dwelling houses. A few pages from it were published in the REVIEW last year and attracted marked attention.

OTHER PUBLICATIONS RECEIVED.

Twelfth and Thirteenth Annual report of the Peabody Museum of American Archæology and Ethnology, Vol. II. Nos. 3, 4; Proceedings of the Davenport Academy of Sciences, Vol. II. Part II. July 1877 to December 1878, and Vol. III. Part I. January 1, 1879; Proceedings of the Thirteenth Annual Session of the Missouri Press Association, held at Columbia, Mo., May 1879, To The Rockies and Beyond, being an account of the health, pleasure and hunting resorts of the mountain regions of the West, by Robt. E. Strahorn, 50 cents; The California Architect and Building Review, Vol. I. No. 5, monthly, $1.50 per annum; The William Jewell College Student, Vol. I. No. 1, $1 per annum; An account of the Tornado of Marshfield, Mo., April 18, by Prof. F. E. Nipher.

EDITORIAL NOTES.

On Tuesday evening, May 25th, the Kansas City Academy of Science held its fourth annual meeting. A very interesting paper was read by Dr. Heath, of Wyandotte, Kansas, upon Orton and Peru, which will appear in the Review next month. Judge West followed with his report of an exploration of ancient barrows in Kansas, which appears in the present issue of the Review. A resolution was passed, thanking the various lecturers of the extra Winter Course for their aid and the pastors of the churches used for their courtesy, and the railroads furnishing free transportation; after which an election of officers for the ensuing year was held.

The extra winter course of lectures furnished by the Kansas City Academy of Science was closed on the 22d ult. by that of Rev. Dr. Laws; and in most respects it has proved a success. The lecturers have been selected from among the best teachers and writers of Missouri and Kansas, and the topics treated by them have been of popular interest and suited to the most diverse tastes. The audiences have been in most instances quite large, and in all from among our most intelligent people.

The Academy has been at great trouble and some expense to secure the services of these gentlemen, to obtain the use of various churches in the city and other necessary matters, but if our people have been entertained and benefited enough to ask for a similar course next winter it will be forthcoming.

Among the later inventions few present points more worthy of consideration among metallurgists than that of employing the electrolytical process of refining the precious metals. It has been patented by E. André both in the United States and Europe, and is in practical use among some of the largest works in Great Britain and on the Continent. This process is said completely and economically to extract the gold and silver from their alloys, leaving the former in the diaphragms at the anodes and depositing the baser metals in a pure metallic state on the cathodes.

As an evidence of the importance and value of the U. S. Signal Service observations and predictions, it may be stated that the verifications of the latter, based upon the former, for the month of March, 1880, amounted to 82.3 of the whole number of predictions made.

Signor N. Perrini, an Italian teacher of astronomy in London, has invented a new planetarium which is free from most of the objections to the old fashioned orreries, whose multiplicity of conspicuous wires and other machinery was liable to confuse the observer. Signor Perrini has his planetarium in a large circular room with a concave dome upon which the movements of the sun, moon and stars, &c., are distinctly and correctly shown by means of motive power which is out of sight above the ceiling.

An important law suit now pending in the courts of Wisconsin involves the exact and probably speedy solution of the vexed question of the agency of wind or electricity in cyclones. The plaintiff sues an insurance company to collect pay for damages done to his property by a noted storm in 1878; basing his claim on the allegation that the storm was of electrical origin and therefore that the company is liable under the "lightning clause" of his policy. Of course the company resists payment on the ground that the property was destroyed by wind alone, regardless of the agency of electricity.

THE lecture of President Laws on the evening of the 22d, upon the Categories of Kant, was a clear, thoughtful and complete account of the philosophy of that wonderful metaphysician, with appropriate comments and just criticisms. It occupied the attention of the audience for over an hour and a half without any evidence of weariness, and when the speaker closed his remarks he was warmly congratulated by numbers of those present. As a lecture proper it was one of the most instructive and valuable of the course which it ended.

THE REVIEW for July will contain, among other original articles, the paper, by Dr. I. D. Heath, upon "Orton and Peru;" also one on the Ancient Mounds and Remains at Madisonville, Indiana, by the well known Archæologist of the Smithsonian Institution, Stephen Bowers, Esq., both of which will be especially attractive and interesting to all readers.

THROUGH inadvertence, we failed to notice the lecture of Rev. Richard Cordley, D. D., before the Kansas City Academy of Science, on April 13. It was upon the subject of Patience in Culture and Investigation, which was discussed in an able, discriminative and eloquent manner, worthy of the man and the occasion. It was expected that an abstract of the essay would be furnished for publication, but we suppose Dr. Cordley's well known modesty deterred him from doing this.

WE are indebted to Rev. James Marvin, Chancellor of the University of Kansas, for an invitation to attend the examinations and Commencement exercises of that institution, between May 31st and June 9th. Railroad fares have been reduced, and everything will be done to render the occasion especially interesting to visitors.

Columbia College has conferred upon General Di Cesnola the honorary degree of LL. D., in token of appreciation of his eminent services in the cause of art.

THE closing and Commencement exercises of the Missouri State University occupy the time from May 25th to June 3d. On Tuesday evening, June 1st, Gardiner Lathrop, A. M , LL. B , of this city, will deliver the annual address before the literary societies. This, as well as the other exercises, will be of a most interesting character.

ITEMS FROM THE PERIODICALS.

THE June number of *The North American Review* contains "Popular Fallacies about Russia," by E. W. Stoughton, ex-Minister to Russia; "Divorces in New England," by Dr. Nathan Allen; "McClellan's Last Service to the Republic," by George Ticknor Curtis; "Has the Southern Pulpit Failed?" by Rev. Dr. F. A. Shoup; "Caste at West Point, by P. S. Michie, Professor of Philosophy at West Point; and "Some Interesting Publications," by M. W. Hazeltine. This number closes the CXXXth volume and sixty-fifth year of the *Review*. During the last few years, this magazine has made a most remarkable advance in popular favor. Many of its numbers have passed through several editions, and its permanent circulation has increased more than six-fold. All the best papers of the country speak of it in the highest terms.

According to the astronomical notes from Vassar College observatory in the *Scientific American*, a large and densely black spot surrounded by the usual gray bordering and accompanied by others of smaller size, may be looked for early in June upon the eastern limb of the sun.

Good Company, for June, has its usual quota of good things, and in addition a very readable article by S. J. Douglass, on Science in High Latitudes, which, in view of the present interest felt in the second Howgate expedition, is very appropriate.

The *American Bookseller* says Winchell's Preadamites (S. C. Griggs & Co.) "is an elaborate and deeply interesting study of ethnology, demonstrating the existence of men before Adam and making careful examination of their antiquity, conditions, peculiarities of race and distribution over the earth. While written in popular style, it is based upon scientific facts which are everywhere quoted to support the conclusions drawn, and history and literature as well are made to contribute to the writer's theories."

On looking over the Proceedings of the Academy of Science of Davenport, Iowa, now one of the most flourishing and notable societies in the west, we came across an account of the tenth anniversary of its establishment, at which "twenty-five persons were present." Quite encouraging to some of our own young Academy who feel discouraged when at an ordinary monthly meeting no more than fifty or sixty persons attend. The Davenport Academy is now nearly thirteen years old; it has its own building, a fine library and an extensive cabinet. Its publications, finely printed and illustrated in the best style of the art, would be creditable in every respect to any similar institution in the country.

The New York Daily *Graphic* says: The Kansas City REVIEW OF SCIENCE AND INDUSTRY (Kansas City, Mo., press of Ramsey, Millett & Hudson) for May is in several respects an advance upon many of its predecessors. The articles are all short and of unusual simplicity and readableness for a periodical of this kind. The table of contents includes five articles on geographical subjects, the two most important of them written for the REVIEW, viz: that on "Expeditions to the Arctic Sea," by Dr. John Rae, of London, and that on "The Second Howgate Expedition." The departments of Psychology, Physics, Philosophy and Meteorology contain original articles on appropriate topics. Professor F. W. Clarke's "Talk About Lightning" should be largely read, containing as it does knowledge needed by everybody. The "Scientific Miscellany" department is filled with carefully selected and interesting matter.

SPECIAL NOTICE.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. JULY, 1880. NO. 3.

GEOGRAPHY.

PERSONAL RECOLLECTIONS OF ORTON AND PERU.

BY DR. I. D. HEATH, WYANDOTT, KANSAS.

James Orton, fresh from Andover, spent two years in European travel. In 1866, while occupying the chair in Natural History in Vassar College, Poughkeepsie, he traveled the continent of South America from west to east, through Equador, by way of Guayaquil, Quito, the river Napo, and down the Amazon. He brought home a large and rare collection of objects in Natural History and from his note book wrote out, in glowing words, the story of his adventures under the title of "The Andes and the Amazon."

Seven years later, in 1873, while the end of the Pacasmayo railroad track in northern Peru was near the 50th mile post, your speaker was standing on the tender of the locomotive which was drawing a train of flat cars loaded with railroad iron to the track layers, when he saw on one of the loads of iron a long-haired, red shirted stranger, in conversation with a civil engineer—quite likely an Irishman asking for employment. Mr. Cartlan called and gave an introduction to Professor Orton. He had just arrived at the end of the track on his second trans-continental journey across South America. This acquaintance was most pleasant, and only ended with his untimely death on lake Titicaca, five years later. The notes of his second expedition were added to the revised edition of "The Andes and the Amazons.

In the northeastern division of Bolivia—the Department of the Beni—there is a province embracing four times the area of the state of Kansas through which no white man has ever passed; through this unknown region flow two rivers—the Beni and the Madre de Dios—of the size of the Mississippi and Missouri. To a scientific traveler who had already seen so much of South America as had Prof. Orton, this unexplored country was of peculiar interest. After four years of careful preparation he sailed for the west coast of South America from New York, in Oct., 1876, to explore the Beni River and country—and the brief story of this expedition is the subject of this address.

Steaming out of Guayaquil Bay, latitude 2° south, the ship passes Tumbez, where Pizzaro effected his first landing for the conquest of Peru, and then out of the tropical heats, out of the great forests, out of the rains to the pleasant lands of the Children of the Sun. Now enjoy a temperate climate, cool breezes and fall clothing. From the ship's deck one can see at the same time the wet forests of Equador and dry, rainless Peru.

The officers of the English steamers which run along the South Pacific coast are very social and delight in making passengers their guests, from the very moment of stepping on board to the hearty "good bye." Captain Hall, of the Oroya, adroitly finds out what one knows of Peru; and, if it is the first voyage, kindly warns the ladies not to step upon the grass and the gentlemen from picking flowers, or stems off the trees if they go on shore at Payta. He assures them of speedy arrest by the police. The captain's joke is quickly understood when they see not a shrub, not a leaf, not a blade of grass—the paved street of a great city is not more dry and barren than the country about Payta. Even the water they drink is brought seventeen miles by rail.

Although the country at first sight so barren and uninteresting, the coast cities are the sea ports of interior valleys of surprising fertility, and even the desert pampas of the Peruvian coast have some time been cultivated, are to-day very fertile, and only need water to produce abundant harvests. Sugar, cotton, hides, sheep and alpaca wool, tobacco, Peruvian bark, freight many a ship. From the coast and plains below, lightning and fierce storms may be seen up in the mountains. A multitude of streams running down from the rains and snows of the Cordillera, supply water for irrigation.

Frequently divided by mountain spurs, the rainless portion of Peru, Bolivia, and part of Chile, consists of long narrow plains more than 2000 miles in length and twenty to sixty in breadth, beginning with a perpendicular ascent of eighty feet from the surf of the ocean and gradually rising up to the mountains. The explanation of the present rainless condition of this Pacific coast seems to be the strong trade winds and cold ocean current coming from the ice fields of the Antarctic Ocean, compressed against the lofty Andean chain of mountains into a chute or arch of moving cold, in which are wanting the atmospheric conditions for condensing of moisture and consequent rain fall. In Brazil, in eastern Peru and Bolivia, and upon the summits of the mountains, the rain fall is abundant.

Many thousands of years ago, the atmospheric conditions of this Pacific coast were probably quite different—a fact indicated by numerous grooves and channels in the dry barren rock of the mountains nearest the coast. There are places in these rocks where water has worn ten, twenty and thirty feet deep, where in these days it does not rain in a lifetime. Besides this, these same mountains, dry, barren and without soil, have a series of stone terraces for hundreds and even thousands of feet up their sides. These terraces must have been constructed thousands of years ago when there was soil upon these rocks and when the rain fall was sufficient to produce vegetation. It is of course plain that in this present climate of no rain nor frost, monuments of man's industry endure almost without change for long ages. When did the rain cease and what was the cause? I will offer that 40,000 years ago this vast mountain chain was 10,000 feet lower than it now is—that then there were soil, vegetation, trees, springs and abundant rain—that the inhabitants during succeeding ages cut down the forests—that the soil was worn off by cultivation and rains—that as the country gradually rose out of the ocean the people built terraces lower down until now the terraces are wanting in soil, in rain, in vegetation, and abandoned by man.

Ruins of a very ancient civilization, probably much older than the Inca monarchy, abound all over Peru.—ruins of temples, roads, walls, acqueducts, foundations of extensive cities and hundreds of square miles of cemeteries. Near Pacasmayo, Trujillo and Lima, there are ruins of temples of adobe still eighty feet high and covering acres of ground, which from their very size and massiveness have defied the vandalic hand of the conqueror. There seems to have been various methods of burial, perhaps indicating the customs of different ages—some dead were buried in structures of adobe, others in the level lands of the plains without wrappings or casings, and others were carefully wrapped and embalmed. In the mouth of the dead is often found a peice of copper, and buried with them bits of gold and silver, and vessels of pottery of infinite variety of shape and design. The vessels probably contained some sacred liquid. Relic hunters have exposed and scattered many miles of human bones.

Our route to La Paz, the capital of Bolivia, was eastward from Mollendo latitude 17° south. Here is one of Mr. Meigg's "railroads in the clouds." Mollendo to Areguipa 107 miles; fare $8.00; daily trains. The track runs along the ocean beach nine miles with the salt spray of the surf dashing against the morning train, and then begins its wonderful zig-zag course up the ravines and around the mountain spurs from whence are magnificent views of the ocean, of the sugar cane and alfalfa fields in the Tambo valley and of the many windings of the railroad track over which we've passed.

From Cachendo across the desert pampa of Islay—desert only from want of water—the snow-clad mountains of Pichupichu, Chachani and Misti, impress one by their massiveness and cold grandeur. At the stations of La Joya and Vitor, oranges, pears, grapes, watermelons and generous baskets of most delicious fresh figs were offered for sale. Here end tropical fruits. From Uchumayu, 7,000 feet elevation, there is laid at a contract price of $3,000,000, a seven inch iron pipe, eighty-four miles to Mollendo, giving water to all the stations, and from this abundant supply every station yard has become a beautiful oasis in the desert. From Vitor to Arequipa the railway train is but a child's toy in the midst of these volcanic mountains and gorges. Arequipa, 7560 feet elevation, is the second city of Peru—population, 60,000. Converging to this point descend the numermerous herds of llamas laden with alpaca and sheep wool, gold, silver, copper and Peruvian bark. The city is built of a white volcanic stone and situated upon the side of the volcano Misti, in the midst of extensive fields of corn and alfalfa, wheat and barley and gardens of vegetables, and surrounded by barren hills powdered with volcanic dust. From the railway station American street cars convey passengers up to the hotels in the city. Streets are paved and well kept. Streams of clear cold water flow freely along side many streets, and plazas are ornamented with fountains and flowers.

But Arequipa is only half way up. The ride from the ocean to this point, and thence to Vincocaya, ninety-six miles further, is well worth a voyage to South America if one would enjoy extremes in nature; a ride by rail from the tropics into the sleets and snows of the Andean heights. By the kindness of Col. Flint, manager, your speaker enjoyed the privilege of making this ascent on one of Roger's locomotives, the Huallata. Standing on the locomotive we, in the afternoon, ran into clouds, then rain, then hail, and then into a blinding snow storm. The road climbs around to opposite side of Misti by a series of "developments" wrought in the hard lava and dejecta from the volcano. Two other trains followed fifteen minutes apart and from different curves and elevations it was wonderful to see the other trains—mere toy trains—hundreds of feet below, worming their way over the same route we had just passed. At 10,000 feet elevation some few of the passengers began to feel the effects of rarefaction of the air of high altitudes—at 12,000 feet many bound cloths tightly about the head—at 14,000 feet many suffered intense headache and sickness, while one or two bled from nose and ears.

At Vincocaya, ninety-six miles from Arequipa and 203 from the ocean, in a sort of broad valley green with Alpine grasses and partly surrounded by mountains of snow, all trains pass the night. The air is thin, cold, frosty; breathing is laborious, head and stomach suffer, sleep is broken; and oh, for one good, satisfying inhalation of air! The highest elevation of the road is 14667 feet above the ocean—more elevated than the highest of the peaks of Colorado. Now we've arrived where there are abundant rains and the surface of the country is grassy and green up to the base of the eternal glaciers. Upon these bleak mountain pampas, great herds of alpacas and llamas feed, guarded by their keepers the Quichua Indians. A thousand feet lower sheep flourish and neat cattle graze.

From the summit the train descends by easy grades over a comparatively level country ninety-eight miles to the city of Puno, on lake Titicaca, 326 miles from the ocean. Puno, capital of the Department, is a city of 4500; building material stone, roofs of tile and straw thatch, streets paved. There are two public plazas graced with iron fountains; one weekly newspaper; "El Ciudadano."

The merchants buy from the surrounding country, sheep and alpaca wool, hides and gold dust. Puno is the centre of a rich mineral region. Near by are the silver mines of Maravillas, Santa Lucia, Manta, and the oil wells of Pusi. There are no trees nor wood for fuel within two hundred miles. Bosta—dried excrement of the alpaca and llama—supplies the place of wood and coal. Agriculture produces potatoes, onions, quinua (mountain rice), oca and papaliz, (similar to the potatoe), and barley. Upon the lake there are two elegant iron screw steamers, the Yapura and Yavar—fuel bosta. Fare to Chililaya, a Bolivian port, $16.40; ninety-six miles.

It is said that the great Andes have, at three different epochs, been submerged beneath the ocean wave; that since the conquest in 1533, the rise has been eighty feet. Lake Titicaca, now shrunken to a trifle less than Lake Ontario, has been carried up to the enormous altitude of 12,548 feet. Ages ago it covered about seven times its present area. A great number of clear mountain streams from every side add to it volumes of fresh water, while the river Desaguadero empties its surplus waters into the salt marshes of Lake Aullaga. There is no other outlet. The cakes of salt from the dry beds of this lake supply all Bolivia. The waters of the *great* lake are somewhat brackish near the shore, but away from land are remarkably clear, sweet and pure. Water birds and fish are abundant.

Chililaya to La Paz, fifteen leagues by a Concord coach, drawn by six mules. All day long we enjoyed glorious views of the snow-covered peaks Illampu, Sorata, Huainapotosi, Illimani. The road passes through a well peopled country, and well cultivated fields, gradually rising out out of the Titicaca basin toward the base of the *snow-piled central* Cordillera of the Andes, until suddenly we gazed down upon the red tiled roofs, paved streets, and lovely gardens of the city of La Paz, 1500 feet below. We could hear the busy hum of industry and the striking of the city clocks.

La Paz contains a population of 80,000, and is 12,000 feet above the ocean. There are two daily newspapers. Her merchants trade in wool, Peruvian bark, coffee, and do business with the gold mines of Tipuhuani and Carabaya, the silver mines of Oruro and Potosi, and with the agricultural districts of interior valleys.

March 27, 1877, we set out on mules from La Paz for Cochabamba, 84 leagues, by way of Oruro, stopping each night at government tambos. Each morning we found the roofs and surroundings white with frost. These tambos afford free shelter for man and beast. All travelers carry their own bedding, and buy food and forage when needed. No wagon has ever passed, except on pack-mules, to La Paz nor to Cochabamba. We met numerous trains of mules and thousands of llamas loaded with flour and metals. In this route we crossed the second Cordillera.

Cochabamba, latitude 17½° south, is a city of forty thousand inhabitants, in the midst of a valley of wondrous fertility; too elevated for any of the tropical fruits, but producing plentiful crops of wheat, corn, apples, grapes, peaches and pears. Cochabamba flour supplies the entire Republic. It is not so white as the celebrated Chile flour, but we pronounced it the richest flavored we had ever eaten in any country. In Cochabamba we spent ten days making collections and gathering information upon the character and productions of the country. Never will be forgotten the delightful climate, the warm hearted generous friends, and the pleasant days we spent in this charming city.

Mules again for the port of Chimorè, on the Chimorè River. The hire of each mule for a journey of fifty leagues was equal to $9.60. We left Cochabamba April 12th, and passing through magnificent fields of ripening wheat, ascended the third and last cordillera. Amid cloud and storm and sleet we passed over the summit. Nothing could exceed the exquisite pleasure and absorbing interest of this descent—first shrubs, then trees, new and strange and of great variety, each mile becoming larger. With the Aneroid barometer in hand, we noted each elevation as we passed down to the potatoe, barley, corn, yucca, fern palm, plantain, orange, coffee, coca, rice, sugar cane and cacao, (chocolate). The professor had been eager to press forward, so that in spite of the advice of friends, we found ourselves in the great forests of the lower mountains at least three weeks too early in the season. We encountered floods of rain and torrents of water. Our pack mules fell in the mud or rolled over down the slippery rocks. Professor Orton, mule and all, fell into the deep torrent of a river. Gnats surrounded us in clouds. We were bitten by them until it was not possible to close the swelled hands. We wore masks to protect the face.

At Pachimoco, a place of a half dozen Indian cabins, on the river Chapare, we first met the Indian of the forests; painted, wearing feathers of the macaw and armed with bow and arrows of extraordinary size. Their only covering a shirt prepared from the inner bark of a tree. The material is abundant, easily washed. and wears well. The Indians live upon plantains and yucca, fish and game of the forest. We were now in the great Madeira platte—the mountains were behind us. Elevation above the ocean by boiling point of water, 875 feet.

It was necessary to travel ten leagues along the base of the mountains to reach the river Chimorè where we would find canoes. In the middle of the afternoon we arrived at the Coni River, but finding it too deep to ford on account of rains of previous night, we camped in the dry bed of the river a mile from shore on a high sand bank near which grew a clump of willows and wild cane. Some Yuracare Indians whom the Cacique had sent with us from Pachimoco, with surprising skill constructed for us a perfect shelter out of the wild cane. They then swam the river, promising to return early next morning with canoes to ferry us over. The night closed in dark and stormy. There were with us the two muleeteers from Cochabamba. They built bonfires to protect ourselves and mules from tigers. By ten o'clock the rain poured in torrents, the thunder was deafening. The lightning was continuous and of intense brilliancy. The river began to rise. In an hour it had risen fifteen feet; it was within a few inches of our shelter and still rising. There was danger. The water invaded our hut; it was eighteen inches deep. We were alarmed. It was time. We drew on our boots and stepped down into the water. We piled our eight trunks together and held them down with poles to keep them from floating away. Only two trunks were above water. The storm ceased—the darkness was intense. We stood in three feet of water. We looked death squarely in the face. We talked of home, family, friends. We gave up all for lost. Huge trees swept by us. The tigers growled, the tapirs bellowed, the monkies chattered, the birds uttered notes of alarm. From the opposite bank masses of earth with portions of the forest went down in the flood. After five hours daylight came. We could see no land. A shout was heard, another and another, but in what direction we could not tell. We answered at random. Two hours later shouts were again heard, and this time from up the river, and in the distance among the floating debris could be seen the heads of swimming men. They touched bottom and waded to us—a score of Yuracare Indians, great powerful fellows. Never were happier men than ourselves. They were friends; we were saved.

From the Coni to the Chimorè, Indian women carried our trunks, each 100 pounds—nine miles for 20c each.

May 3rd, 1877, We embarked on the Chimorè River in two canoes, paddled by thirteen Indians. Here the current was swift, with many rapids; banks four feet high and crowded to the very edge with the dense tropical forest, so that the river seemed hemmed in by two immense walls of living green. Silently each Indian bid "good bye" with a pressure of the hand, and took his seat in the canoe, placing his bow and bundle of arrows by his side. The tears coursed down the cheek of more than one Indian wife; we pushed out into the stream; the paddlers bent to their work; the canoe rose and fell in rythmic response to each united pressure of the paddles; we moved almost with the speed of the arrow, and began our voyage of 300 miles. By two o'clock, not a mountain nor a hill was visible. Time down to Trinidad six days—time back up stream, twenty days. In four days we found the river as large as the Missouri, with soundings of thirty to seventy feet. We camped each night upon a sand bar to be safe from night attack of hostile indians—Los Salvajes, as our Yuracare captain told us in Spanish.

(*To be continued.*)

GEOGRAPHICAL NOTES.

AFRICAN EXPLORATION.

The English expedition sent out by the Royal Geographical Society has so far been very successful. This expedition, it will be remembered, left the coast near Zanzibar in May, 1879, under the leadership of Keith Johnstone, Jr., after whose sad death his companion, Joseph Thomson, took command. After a march of 131 days he reached the north end of Lake Nyassa September 22. The highest point passed by the expedition between the coast and the lake had 8,116 feet elevation above the sea. After five days' rest Thomson continued his march to the west, and in thirty-five days succeeded in accomplishing the chief object of his expedition by crossing the hitherto entirely unknown region between Nyassa and Tanganyika, which he found to be 250 miles broad between the two lakes, with mountain ranges 6,000 to 9,000 feet high and inhabited by numerous peaceable and friendly tribes. Having reached Pambete, near the southern end of Tanganyika, on the 5th of November, he then went on to Ujiji on the eastern shore, where he stayed till January 16, when he started on his return journey to the coast. He first crossed the lake to the western side, intending to explore the Lukuga Creek, passing down the river about thirty miles, in order to finally solve the questions raised by Cameron and Stanley regarding its character as to the lake's outlet. He would then march south through the still unexplored region west of Tanganyika, and passing its southern end return to Kilwa on the east coast, which he hopes to reach in six months. Mr. Stewart, with the Livingstonia Mission, expedition also succeeded in crossing the country between Nyassa and Tanganyika, reaching the latter one day after Thomson and by a different road. Thus another of the many white spots on the map of Africa has at last been filled in.

THE ROYAL BELGIAN EXPEDITIONS.

The expedition which was sent out from Zanzibar by the International African Association, founded by the King of Belgium, has also attained some real successes after all its misfortunes. The first expedition, commanded by Lieutenant Cambier, reached the eastern shore of Lake Tanganyika in July last, being over one year on the march which Stanley, in 1871, accomplished in less than eight months. At Karema, in Ufipa, in latitude 7 degrees south, Cambier purchased a piece of land of 1,000 hectares from Masikamby, the chief of the district, and there established the first scientific and commercial station of the association in Africa. It was Stanley who pointed out this spot as the most suitable for the purpose. The station, which consists of several wooden houses, numerous huts for the negro followers and a magazine for the goods, is situated on a deep bay near the village of Karema, which lies some ten to twelve days by boat south of Ujiji, on a small promontory, elevated twenty feet above the lake. Ufipa is a fertile, well watered country, inhabited by quiet and friendly natives. It contains some coal beds, and seems fit for raising grain and wild rice. The Arabs also have a station near Karema, which consists of 150 grass huts, with 250 inhabitants. The second expedition, under Captain Popelin, after combining with No. 3, commanded by M. Cartier, at Mpwapwa last August, pushed on to the west, passed through the Arab capital, Tabora, in October, and by the last accounts had just arrived at Karema. Of the eight Belgian explorers who originally started for Tanganyika only three have thus succeeded in reaching the lake—three died on the road and two were forced to return as invalids. Of the four Indian elephants with which Cartier left the coast two have died on the way, but the other two reached Karema in good condition. They are now entirely acclimated, and have proved of immense service to the expedition. When crossing the Mgunda-Mkali desert, carrying a load of twelve hundred weight each, they traveled consecutively for forty-two hours without food and thirty-five hours without water. In passing through the villages they naturally created great wonder and excitement among the natives, who only know the animal in its wild state. It is now proposed to establish a station near the lake for catching, taming and training the African elephant for transport service. For this purpose Mr. Sanderson, the noted elephant tamer, with a staff of experienced elephant catchers, will come from India to Zanzibar. While the expeditions now at Karema are solidly establishing themselves in that station, the basis of all future operations, a fourth expedition has organized at Zanzibar and started for the interior on January 25. Its leaders are two Belgians—Burdo, who has already traveled on the Niger, and Roger, and an Englishman, Cathneade. Their caravan is 150 men strong, in light marching order, and takes along a number of donkeys as a new experiment in transport service, but the *tsetse* fly will probably prove fatal to these animals. The expedition, which is expected to reach Karema in May, will pick up Dr. von Hemoel at Tabora, where he was left behind by the second expedition on account of ill health. After all these expeditions have assembled at Karema a fresh start will be made with a new expedition under Popelin, Cambier and Burdo, who will follow Cameron's and Stanley's road through Mamyuema to Nyangwe, the westernmost Arab trading post on the Lualaba Congo, where the second fixed station is to be established. Here they will await the arrival of Stanley's expedition, which is at present engaged in pushing up the Congo from the west coast, as described further on. Ultimately a complete chain of stations is to be stretched across Africa from ocean to ocean.

FRANCE AND GERMANY.

This grand project of the International Association at Brussels is, however, not to be executed solely by its own expedition, but the necessary funds have been assigned to the sub-committees in France and Germany for establishing their share of the explorers' stations in Africa. The French committee, with a fund of $20,000, including a government grant, has appointed the noted traveler Count Savorgnan de Brazza as chief of the station which is to be formed near the French Gaboon colony on the west cost, while the eastern station will be established at Tabora, in Unyamwezi. The chief of the latter, who will also be a naval officer, has not yet been appointed. Count Brazza started for his post last December with his former companion, Dr. Ballay, with whom, after founding the station on the Gaboon, he will continue the exploration of the Ogoway river. The German Committee, having received a donation of $10,000 from Brussels, has organized a new expedition, which started from Berlin a few days ago for Zanzibar. It consists of Captain von Schoeler, the chief of the station; Dr. Boehm, as naturalist; the Engineer Reichert and Dr. Fischer, who explored the Dana River with Denhardt in 1878 and has since resided at Zanzibar. They are instructed to go to the Tanganyika and establish the first German station near the southern end of that lake, as the above described expedition of Thomson has demonstrated the importance of the high road leading thence to Lake Nyassa, the Zambesi River and the coast.

Three other German explorers, sent out previously by the Berlin society, have meanwhile continued their work. When Gerhard Rohlfs returned to Berlin after the complete failure of his expedition to Wadai and the Congo, having been robbed and nearly murdered by the fanatic inhabitants of the Kufarah oasis, he resigned the command, which was then transferred to his companion, Dr. Anton Stecker, who was instructed to make a new start for the interior by another road. Dr. Stecker left Tripolis last February, and now follows the great caravan route, due south, by way of Fezzan, to Kuka, the capitol of Bornu, on Lake Tsad. From there he will attempt to pass either south through Baghirmi or southeast through Adamowa, in order to reach the original goal of the expedition—the great unexplored region between the head waters of the Shary, Welle, Binne, Ogoway and the north bend of the Congo. Dr. Oscar Lenz, the second envoy of the society, arrived at Tangiers, in Morocco, November 13, and went on five days later by way of Tetuan to Fez, in the interior. In December last he started for the south, intending to cross the high Atlas range and reach the oasis of Tafilet, from where, if possible, he will push on to Timbuctoo, on the Niger. The third German explorer, Dr. Max Buchner, who started from Loanda, on the west coast, reached Malange, in the interior, July 22, with 130 followers, passed through Mutua Ngengo August 10, and was near the Lui River, north of Quimbundu, in Sangoland, September 22, from where he dates his last letters. After crossing the Kwango he will follow the northern road to Quizimene, the Mwato Yanvo's present capital, as the southern road is at present closed by a war among the natives. Having delivered the German Emperor's presents to the Central African monarch he will attempt to penetrate north to the mysterious Sankowa Lake and thence to Nyangwe and the east coast.

PORTUGUESE, SPANISH, ITALIAN.

The Portuguese explorers Ivens and Capello returned to Loanda last December, ill with fever, nearly destitute of clothing and deserted by nearly all their followers. During their two years' expedition in Angola they have pretty thoroughly explored the interior of that colonial province, and especially the highlands of Bihe with its river sources. They also surveyed the regions of the Kwango and Kwanga rivers, and col ected many geographical, topographical and meteorological details. They descended the Kwango as far north as the bush of Iaca, which is a vast region south of the Congo between latitude 5° and 7° south, but were prevented from going on to the great river by the hostility of the natives. After recuperating their health for some months at Mossamedes they returned to Lisbon on the 1st of March. Señor Albergnes de Sosten, the leader of the first Spanish expedition in Africa, is now at Alexandria. After completing his outfit he will start for Massowah, on the Red Sea, and thence to Adowah, in Northern Abyssinia, from where he intends proceeding southward through Amhara and Shoa and by way of Guragwe, south of the Blue Nile basin, through the wild Galla and Somali countries as far as the Juba River, on which he will descend to the Indian Ocean, where he expects to arrive in twelve months, if not detained by the hostile tribes, as is but too probable. The Italians are also taking an active share in African exploration. Their Commercial and Exploratory Society has recently established stations at Massowah, Odeida and in the Abyssinian interior for the purpose of trade with the natives, and the dispatch boat Exploratore has hoisted the Italian flag at Assab Bay, near the Straits of Babelmandel, and landed mechanics and artisans there to build a settlement, which is to serve as a starting point for Italian expeditions into the interior. In February last Prince Borghese and Dr. Matteucei began their new expedition. They intend to go from Chartum on the Upper Nile westward through Darfour and Wadaii to Bornu, and thence, according to circumstances, to the Guinea coast or northward to Tripolis.

OTHER NEW EXPEDITIONS.

The Russian explorer, Dr. Junker, has again started for Central Africa. He left Cairo December 1, and goes by way of Suez and Snakin on the Red Sea to Chartum, his goal being the Monbuttu country beyond the Welle River, where he intends completing Schweinfurth's researches among the Acka dwarfs and Niamniam cannibals, and if possible descend the river either to Lake Tsad or the

Conyer, and thus establish its identity with either the Shary or Stanley's Aruwimi. He is accompanied by Bohndorf, Gordon Pacha's ex-valet, whose adventurous journey to Darbanda was described in the last letter. The Austrian traveller, R. Slatin, reached Dara, in Darfour, last September, and intends to go south to Kalakka end explore the unknown regions as far as the copper mines of Hafrat-el-Nahas and the Upper white Nile. Baron Muller-Oskon-Capitany has also started for the Egyptian Soudan and proposes to go by way of Kaffa, south of Abyssinia, to the sources of the Juba. Captain Revoil, formerly of the French army, has made a successful trip in the land of the Midjurten Somalis, south of Cape Guardafni, where he was well received. He did not, however, go far into the interior, but succeeded in collecting much valuable information about the caravan routes, and also ascended several of the high mountains, as the Karomo (11,480 feet) and the Aisemat (7,080 feet). The German Baron Holzhausen and Dr. Moak have made an expedition into the country of the Dabanja-Bedouins, on the Upper Atbara River, visiting Kassala and Tomad, the chief's winter camp, last February. They report that complete anarchy prevails in that part of the Egyptian Soudan, robber bands infesting the whole country. The blame for this state of affairs is attributed to Gordon Pacha's constantly changing policy and shifting projects, with spasmodic attempts at suppression of slavery, but without any definite plan for the security and pacification of the country.

EXPLORATION IN THE SOUTH.

In South Africa the conclusion of the Zulu and other Kaffir wars has permitted the resumption of explorations. F. C. Selous, who has lived many years on the Upper Zambesi and its tributaries, and has before attempted to reach Lake Bangwealo, the source of the Lualaba-Congo, is about to start from the Transvaal on another expedition with the same object, and thus span what has been called "the unconnected link between the Cape of Good Hope and the Mediterranean." At Cape Tower two young Englishmen, Bagot and Beaver, are preparing an expedition at their own expense, with which they propose to explore and survey for four years the region between the Zambesi and the great lakes, traveling with two ox carts and native drivers and guides. Donald McKenzie has again returned to the settlement, which he has found near Cape Juby, on the west coast, and named Port Victoria. He will first replace the wooden houses of the colony by stone buildings, for which some quarries close at hand furnish good material, and then explore the neighboring country, especially the ruins of a Portuguese fort of the fourteenth century not far distant. His chief object, however, remains to open up trading connections with the native chiefs in the interior as far as Timbuctoo. The Governor of the British colony at Sierra Leone also intends sending out an expedition to go from Bathurst, on the Gambia, by way of Segu, on the Upper Niger, to Timbuctoo by invitation of the Sultan.

ARCTIC EXPLORATION.

At the regular meeting of the Geographical Society of Berlin, April 10th, 1880, the President, Dr. Nachtigal, read a letter received from St. Petersbrug giving an account of the various attempts made in the course of the year 1879 to establish regular intercourse by sea between the ports of Europe and the estuaries of the great rivers of Siberia. In 1879 seven ships attempted to reach Siberia from Europe by the North Cape, but of these only one, the steamer Luise, was successful. With two barges in tow, this vessel left Bremen on the 8th July, arrived in the Yenissei on the 15th September, and returned in good condition to Bremerhaven on the 30th October. The cargo consisted of petroleum, sugar, butter and tobacco, and the return freight of about 20,000 pounds of wheat which had been brought from the interior of Siberia to the mouth of the Yenisei in boats specially built for this purpose. All the other ventures were complete failures. The two Swedish vessels, the Samuel Owen and the Express, freighted by the well-known Moscow merchant, Sibiriakoff, endeavored in vain to force a passage through the masses of ice accumulated at the entrance of the Kara Sea, and were compelled to return. Still more unfortunate were the two steamers, Amy and Mizpah, bound for the Obi and chartered by the merchant Fund, as also the Danish steamer Neptun, dispatched on account of the same firm, and which, as well as Mr. Ketley's English steamer Brighton, came to grief in Baidarak Bay. A similar fate was in store for three sailing vessels which after having been built in the dockyard of Trapesinkow at Tjumen (Government of Tobolsk), were laden with grain, tallow and spirits, and sailed for Europe. The Nadeshda and the Ok were shut in by the ice in Baidarak Bay, near the Tambata Rives, and lost their tackle as well as part of the cargo; the Tjumen and the steamer Luise (the latter had wintered in the Obi) ran on sand banks in the Gulf of Obi and were thus prevented from continuing their voyage. These shipping disasters have caused great surprise at St. Petersburg, where Professor Nordenskiold's voyage had been hailed as the commencement of a new epoch in the Siberian trade. The advocates of communication by sea with Siberia point out that 1879 has been an exceptionally unfavorable year, and that most of the accidents were due not so much to the state of the ice in the Kara Sea, as to the want of charts, buoys, beacons, etc. It is also suggested that while there must have been in that year a great accumulation of ice in the Kara Sea, the sea round Novaya Zemlya just about the same time was free from ice, and we may conclude that in each year, according to the direction of the prevailing wind, one of these two routes will be open to navigation; an opinion to some extent confirmed by the voyage of the English Captain Markham, who at the end of September, having found the Kara Sea encumbered with ice, sailed without obstacle round the northern extremity of Novaya Zemlya. Unfortunately our experience does not date further back than the year 1875. It is possible that the year 1879 may have been exceptionally unfavorable, and its immediate predecessors exceptionally favorable to Arctic exploration, and as observation alone, extended over a number of years, can prove the correctness of this assumption, it is recommended that scientific observing stations be established on the northern coasts of Europe. Matotschkin Schar in Novaya Zemlya and the island of Waaigat offer themselves as meteorological stations where exact observations might be made as to the direction of the wind which renders Kara Strait, or Jugor Strait, or the Matotschkin entrance, free from ice, and the results thus obtained might be communicated to approaching vessels. The letter went on to say that an examination of the difficult navigation of the Obi, and the discovery of a suitable harbor in the Gulf of Obi were also urgently required, as the conditions of the latter were much more unfavorable than those at the mouth of the Yenissei. As a matter of curiosity the suggestion was alluded to that the difficulties of navi gating the Obi might be altogether avoided by the construction of a railway connecting the Charua-Juga, a tributary of the Obi, with Khaipudirskaia Bay (60° east long. of Greenwich). The President further announced that the expedition which purposes to found a station in East Central Africa, and which is composed of Captain von Schloer, the zoologist, Dr. Boehm, Dr. Kayser, for geodesy, and the civil engineer Mr. Reichard (the latter accompanying the expedition at his own expense) was about to start from Berlin, and would probably establish a station at the southeast end of Lake Tanganyika. H. M., the King of the Belgians, had contributed for this purpose 40,000 francs, and the German-African Society their subscriptions for the year 1880, which amount to 16,000 marks. Dr. Boehm next addressed the meeting on the discovery of the sources of the Niger; and Dr. Stolze gave a description, based upon his own observations, of Faristan, the cradle of the old Persian nation.

THE FRENCH IN THE SAHARA.

The French project for building a railway from Algiers across the Sahara desert to the Niger and thence to their colony on the Senegal has caused the sending out of several expeditions for determining the most suitable line, for which purpose the Ministry of Public Works has received a grant of $120,000. A though the railroad may never be built, geographical science is sure to profit by these explorations. Three separate expeditions have been organized in Algeria, of which the first will operate only in the colony, while the second explores the Algerian Sahara not beyond the oasis of El Goléa. Their leaders are M. M. Pouyanne and de Choisy. The third and chief expedition, which is under the command of Colonel Flatters, started from Ouargla oasis on the 5th of March. It consists of the leader, nine scientific companions, including Dr. Guyard, of the Anthropological Society, and some engineers, surveyors, etc., an escort of twelve French and sixteen native soldiers, the later being frontier Arabs, and sixty-eight camel drivers and servants of the Chambaas tribe, a total of 106 persons. The materials and supplies are transported by fifteen horses and 220 camels. Colonel Flatters intends reaching Temassauin, nearly three hundred miles due south of

Ouargla, in seventeen to eighteen days; then cross the Ahaggar plateau and push on through the desert to the Soudan. Meanwhile the noted traveler, Paul Soleillet, has gone back again to Senegambia to make a survey for the Trans-Saharan Railroad in that direction. He feels confident of not only reaching Timbuctoo this time, but also of crossing the desert to Algeria. At the same time M. Lecarte has been sent out by the government to explore the regions between the Senegal and the Niger. In October last two Frenchmen, MM. Zweifel, and Moustier, starting from Treetown in Sierra Leone, succeeded in crossing the coast range and discovering the ultimate sources of the Djoliba branch of the upper Niger, near the village of Kulako. Many travelers, including Caillié Mage, Winwood Reade, Solleillet, etc., had previously attempted this feat, but all failed. The French also intend to explore the Gamba River thoroughly and open it for trade. For this purpose a river steamer is now being built in England, which is to be 105 feet long, sixteen broad and eight deep, with engines of thirty horse power and a speed of nine knots. As this boat is intended to carry sixty tons weight on five and one-half feet of water it will be able to ascend the river for nearly 200 miles from its mouth and open up the hitherto unexplored regions near its sources.

RELIGIOUS MISSIONS.

The French and English missions in the lake regions must not be omitted in an account of African exploration. Advices received by the Archbishop of Algiers state that the Catholic mission under Father Livinhac, in Uganda, on the north shore of the Victoria Nyanza, still enjoys the protection of King Mtesa, but that the Church Missionary Society's station at Rubaga, the capital, has been abandoned by the Rev. Mr. Wilson and his assistants on account of difficulties with the king. Two members of the second expedition of the London Missionary Society to Lake Tanganyika have reached the station at Ujiji, but the third had died *en route*. They traveled on a new road from Mpwapwa to Urambo, the capital of King Miramboo, Stanley's friend and the foe of the Arabs, whose death has been positively asserted recently. The English missionaries at Ujiji have explored parts of the lake, and Mr. Hore, the scientific member, asserts that the Lukuga is the real outlet. The Jesuit missionaries to the Tanganyika have also arrived at Ujiji, where they were well received by the English and Arabs; their leader, M. P. Pascal, however, died on the way. Their new superior, P. Deniand, has since circumnavigated the lake, and they have now gone on to Ulundi, on the north east shore, where the chief of Bikari has offered them land for a station. The reinforcements for this mission, comprising twelve missionaries from Algeirs and six former Papal Zouaves, have passed through Ugogo.

STANLEY ON THE CONGO.

Stanley's new expedition on the Congo, promises to become the greatest undertaking ever attempted in African exploration. Since his arrival at Banana, the Dutch station at the mouth of the Congo, Stanley has taken the entire expedition, with his fleet of five small steamers and several small boats, up the river as far as the first Yellala falls. At Vivi, opposite the second rapids, and 130 miles from the coast, he has erected his first station on the right bank of the river. His camp, consisting of movable wooden houses, magazines, sheds, ètc., stands on a small plateau surrounded by precipices, 200 feet above the river level. The expedition is very numerous, comprising about one hundred negroes from Zanzibar, Sierra Leone and the Congo, and some twenty whites of different nations—Belgians, Americans, English, Italians, Danes—and including a superintendent, a captain for the boats, engineers, surveyors, mechanics, carpenters, sailors, etc. Stanley and all his men are now hard at work building the road through the wild coast range of mountains to transport the boats and supplies overland past the terrible series of the thirty-two Livingstone Falls. As soon as Stanley Pool, which is above the last fall and 200 miles distant, has been reached, the second station will be established on its shores as a basis of supplies, and the fleet of steamers will be launched on the river. Nothing will then prevent Stanley from ascending the great river and its powerful tributaries and penetrating to the very heart of Africa.

AFRICAN EXPLORATION.

The German African Society, in the last number of its *Mittheilungen*, publishes a list of all the scientific expeditions sent out by the (former) German Society for the investigation of Equatorial Africa, and by the new society (under its present title) during the years from 1873 to 1879. All together there were no less than eight expeditions, viz:—

1. The Loango Expedition, and to the Chinchoxo Station, 1873–1876; cost, 10,532 l. less 1,133 l. realized from sale of specimens: leader, Dr. Paul Güssfeldt, not Prof. A. Bastian, (who took part at his own expense in the preparatory steps for the establishment of the Chinchoxo Station).

2. The Ogowe Expedition of Dr. Oscar Lenz, 1874–1876; cost, 1,563 l.

3. Cassange Expedition, 1874–1876; cost, 4457 l. Members: Capt. A. Von Homeyer, Dr. Paul Pogge, Herm. Loyaux, Lieut. A. Lux.

4. Eduard Mohr's Expedition, 1876; cost, 692 l.

5. Engineer Schütt's Expedition, 1877–1879; cost, 2,590 l.

6. Dr. Max Buchner's Expedition, since 1878; cost, (till October, 1879,) 1,523 l.

7. Rohlfs' Expedition, since 1878; cost, (till October, 1879,) 2,225 l. Members: Dr. Gerhard Rohlfs, Dr. Anton Stecker.

8. Dr. Oscar Lenz's Expedition to Warrocco, since the end of 1879.

SAFETY OF COL. PREJEVALSKY.

A letter has been received at St. Petersburg through Pekin from Col. Prejevalsky, dated from the town of Si-Ning, March 20th, announcing that the expedition under his command is safe. He left the Nan Shian mountains in July, and entered Thibet through Shaidash. His party was attacked by Tanguts, of whom they killed four and put the remainder to flight. The Thibetian troops stopped the progress of the expedition 250 versts from Hlassa, and a messenger from the Grand Lama of Thibet brought the refusal of the Thibetian authorities to allow the Russians to proceed. The latter were therefore obliged to return, which they did with some difficulty through Northern Thibet, wintering at a height of 16,000 feet above the level of the sea. Col. Prejevalsky expects to reach Kiakhta in August by way of Alashan Urgu.

ANTARCTIC EXPEDITION.

The bulletin of the Italian Geographical Society for April contains full details of the proposed Antarctic Expedition under Lieut. Bove, with a carefully compiled map of the south polar regions so far as these have been hitherto explored.

AN UNKNOWN REGION IN SOUTH AMERICA.

The work of exploration has been carried forward to such an extent that few portions of our globe remain unknown to men In this work geographical societies have vied with each other, and the various governments have been lavish in expenditure. The poles are still a *terra incognita*, but under the plan of Capt. Howgate the North Pole will probably very soon give up its secrets. He is preparing to establish with his present expedition a colony, at a high latitude, at a point where they have recently discovered an immense bed of coal. This colony can be recruited with men, and supplied with provisions, and expeditions conducted with sledges over the ice, starting at such a latitude and taking advantage of the season, will have everything in their favor for reaching the pole.

In South America there is also an unknown region. Much has been done on that portion of the American continent by Humboldt, Orton and others by the way of exploration; still, on the upper waters of the Amazon, there is a vast region of which our maps of that country are mere guesswork. The best informed are in dispute in regard to the course of some of the large affluents of the Amazon, the animals and plants are entirely unknown, and the mineral resources of the country are unexplored. It was the cherished plan of Prof. Orton, in his last expedition to South America, to explore this unknown region so much dreaded by the natives, and open its secrets to the world. But, when he was on the very point of accomplishing his purpose, his guard, composed of native soldiers, suddenly, by concerted action, placed their bayonets at his breast, and marched back whence they came. Baffled in his plans, worn out by travel and weakened by exposure and the rarified air of the elevated plateaux of South America, he died without a struggle, a martyr to science, on the magical waters of lake Titicaca.

Since his death, Dr. I. D. Heath, who was his assistant during his entire expedition, and his brother, Dr. Edwin R. Heath, who has resided in South America for many years, have proposed to complete Prof. Orton's unfinished work. Recently a letter has been received from Dr. Edwin R. Heath, who, it will be remembered, read a paper before the Kansas City Academy of Science two years ago, on Peruvian Antiquities, which was republished in Europe. Dr. Heath is at present located at Los Reyes, in eastern Bolivia. He is engaged in studies and in making collections in the interest of science, and in organizing his contemplated expedition to complete the work so suddenly terminated by the death of Prof. Ort n. His object is to explore the unknown countries drained by the waters of the Beni and Madre de Dios, an undertaking full of difficulty and danger, but for which he possesses the personal qualifications, many years of experience, and a thorough knowledge of the Spanish language and character. South America is a paradise for scientific explorers, being rich in every possibility. Dr. Heath is full of enthusiasm in his work, and is confident in being successful in making known these unexplored regions. He hopes to achieve results adequate to the importance of the field in which he operates. He pays the expenses of this great work out of his own private funds, which are wholly inadequate to the scientific and commercial value of such an undertaking. If some geographical or scientific society, or well endowed institution of learning would unite with and assist him in bearing a portion of the expense of the expedition, and send two or three experts, perhaps post-graduate students, for a division of labor, it is believed that this portion of the world, now absolutely unknown, would furnish results in geographical knowledge, and scientific collections, of such great interest and value as many times to repay the expenditure.—*Kansas City Daily Journal.*

ARCHÆOLOGY.

ENGRAVED STONE FROM OHIO.

BY REV. STEPHEN BOWERS, PH. D.

During a recent visit to Cincinnati the writer, in connection with several archæologists, had the pleasure of examining an engraved stone, taken from a mound in Brush Creek Township, Muskingum County, Ohio, by Dr. J. F. Everhart, of Zanesville. The mound in which the stone was found measures sixty-four by thirty-five feet at the summit, gradually sloping in every direction, and is eight feet in height. The stone was found leaning against the head of a sort of clay coffin inclosing the skeleton of a woman measuring eight feet in length. Within this coffin was found the skeleton of a child about three and a half feet in length, and an image that crumbled when exposed to the atmosphere. In another grave was found the skeleton of a man and woman, the male skeleton measuring nine feet in length and the female eight. In a third grave occured two other skeletons, male and female, measuring respectively nine feet four inches and eight feet. Seven other skeletons were found in the mound, the smallest of which measured eight feet, while others reached the enormous length of ten feet. They were buried singly, or each in separate graves. At one end of the mound was found a stone altar about twelve by four feet, containing portions of what seemed to be charred human bones.

This mound was opened by the Brush Creek Township Historical Society, and under the immediate supervision of Dr. Everhart, who was present when the tablet was found, and who measured the skeletons in *situ*. The Tablet is of unfinished sandstone, not quite square, the greater length being twelve and one-half inches and breadth eleven inches; thickness four inches. The stone has not been squared, nor the surface upon which the characters are engraved so much as leveled, nor is there any sign of tools having been used upon the stone except in cutting the hieroglyphics. There are two rows of these characters with a straight line about one eighth of an inch deep and wide, cut above and below each row, or parallel thereto. The characters are clearly and carefully engraved and are from one sixteenth to an eighth of an inch in depth and width, indicating no little skill in their execution. Between the rows of characters is a circular depression one and three-fourth inches in diameter and about five-eighths of an inch deep, with other but smaller depressions in the stone.

It is not the purpose of the writer to speculate concerning this find nor even to attempt a description of the characters themselves, further than to say, that while two or three of these inscriptions indicate an acquaintance with the old

Greek alphabet, others may probably be referred to Egyptian and Hetruscan. But while we found fair representations of Egyptian, Greek, Punic, and other characters, we risk no general interpretation of their writing. Mr. Everhart believes that the circular depressions refer to the heavenly bodies, and concludes that this giant race were sun worshipers, a not improbable conclusion.

Were the writer to risk an opinion concerning the *design* of these inscriptions, he would suggest that they refer solely to those buried in this mound. The tablet contains three V shaped characters similar to those found in the Great Pyramid, and which Prof. Piazzi Smith, and others, refer to as symbols of power or distinction. In this case they may refer to the three important graves found in this mound.

As to the genuineness of the find there seems to be no room for doubt, as Dr. Everhart, an intelligent explorer, took it out in the presence of a number of witnesses. As to age, it bears the marks of antiquity. It is doubtless as old as the mound from which it was exhumed.

Messrs. Robert Clark, Charles L. Low and Dr. H. H. Hill, gentlemen of more than local celebrity in archæological science, to whom, with the writer, is was submitted for examination, gave Mr. Everhart a written statement of our views concerning this tablet, concluding as follows: "We have examined this stone very carefully after hearing Mr. Everhart's statement concerning it, and we are satisfied that it is not of recent procuction, but has every appearance of being a veritable Mound Builder's relic, and is well worthy a serious effort to unravel its mysteries."

THE HAIR AND BEARD AS RACIAL CHARACTERISTICS.

Prof. Otis T. Mason in the *American Naturalist* for June, in commenting on various anthropological papers in the *Revue d' Anthropologie* says: The article of Mme Royer is designed to show that the human race is descended from a species of animal that never had any hair, in opposition to the generally received theory that our race has lost its hair in time. Following close after this domes Mr. Wake's paper upon the beard, and on pages 170-175, a review, by M. Vars, upon Ecker's "Systéme pileux et ses anomalies chez l'homme," so that three-fourths of the original communications of the number relate to this external characteristic. After a very extended collation of authorities who have remarked upon the abundance or scarcity of hair upon tribes in all parts of the world, Mr. Wake concludes with Peschel that the beard is a good racial characteristic, and "that there are races upon whom it is developed in all its exhuberances, while there are others in which this distinction appears to be incompletely produced." The author then goes on to seek the causes of this difference. The growth of hair upon the face cannot be attributed to such causes as alimentation and climate. Doubtless these have had their effects; but the true cause must be sought in the sum total of all the influences, moral as well as physical, to which the organism has been subjected. According to this theory, the most general and complete development of the beard should be sought among the races which have been most favorably situated or the longest exposed to the conditions favorable to its production. Beardless races, in this sense, may be compared to children, and those that are bearded to adults. If the beard be a social mark, we seem to be authorized to affirm that bearded races are more nearly related to one another than to those that are beardless.

He also refers as follows to the "Essay on the Bible narrative of Creation," by Prof. A. R. Grote, of Buffalo, N. Y.: "Whatever opinion our readers may have as to the weight of authority quoted, or concerning Prof. Grote's ability to guide us in this most intricate problem, no one will question his scientific attainments or his disposition to treat the subject fairly and his opponents kindly. The gist of the treatis is best given in the author's own words." If there is one subject which now seems to me more important than another, it is the bearing of our recognition of the process of evolution upon the existing state of our religious creed. It is not that the teachings of Christ are to be rejected, or the morality of the Hebrew Bible to be condemned, but that we are to correct our views as to the way in which existing plants and animals (including man) came to be what they are to-day. For Astronomy and Geology the struggle is nearly over. Out of this struggle has sprung the fatal error of believing that our knowledge in these branches does not contradict Genesis, or that a reconciliation is possible. But with biology the struggle is now going on. It is imagined that the six days mean really periods, although from the context the meaning is shown to clearly agree with the words, since the morning and evening are given to limit the term and decide the intention. It cannot, indeed, be too often remembered that people did not write in early times what they did not mean. The study of Genesis, or the origin of things, religion must surrender to the sciences.

PHYSICS.

UNDULATORY MOVEMENTS AS AFFECTING OUR SENSES.

PROF. T. BERRY SMITH, NORTHFIELD, MINN.

Let us inquire into the nature of undulatory movement.

You have all seen the waving of grain fields when the wind was sweeping across them.

Did you ever think of the steps necessary for the production of the waves which you saw?

Let us follow one head of wheat in its movements and find out what it does. Now it is standing still and erect. In a moment the wind comes in a gust and the head is bent far forward; then by reaction like a pendulum it rises, swings back and passes beyond its original position to a point about as low as when bent farthest forward. The movement may be repeated many times, but we have seen all that that particular head does. When erect it is at its highest point and when bent farthest forward it is at its lowest point. We learn from this that the heads of grain are performing movements which are transverse to the line along which the wave is moving. In like manner do the particles of a rope move when you catch hold of one end of the rope and cause a wave motion along its entire length. And water waves are caused in the same way.

Again, take an elastic wire, coil it into a spiral, support one end firmly, to the other end fasten a weight, and cause the weight to vibrate up and down by pulling it downward and then freeing it. Evidently the coils of the spiral are at one time stretched apart and at another time crowded together, as the weight vibrates up and down. That is, the particles instead of moving *transverse* to the line of wave motion are moving *parallel* with it.

To sum up, then, there are two classes of undulatory movements:

1—Those in which the elements of the wave move transverse to the line of direction of the wave; and

2—Those in which the elements of the wave move parallel with the line of direction of the wave, i. e. there is alternate condensation and rarefaction among the elements of the wave.

Now there are four classes of material substance with which we have to deal:

1—Masses.

2—Molecules.

3—Atoms.

4—Radiant matter, called "Ether."

We look up to those great masses we call stars and learn that they are forever in motion. We explain the solid, the liquid and the gaseous conditions of matter by saying that the molecules are in motion and are only closer together in the solid than in the fluid. By analogy and by the researches of such men as Crookes and others, we reason that atoms and ether particles are likewise in continual motion. Thus we are led to conclude that in matter nowhere "can rest be found."

The constituent particles of all matter are forever unstilled.

If I have made myself understood thus far, I shall now proceed to use these facts in explanation of the actions of our various organs of sense. I shall try to demonstrate that these various organs of sense are so endowed that each takes cognizance of certain rates of undulatory motion and transmits its impressions to the brain. How these impressions are transmitted to the brain, I shall not pretend to say—that is beyond the scope of material science; but I do want to show that the nerves of these organs are affected by and receptive of undulatory movements within limits ordained for each particular organ. In the cases of the ear and the eye, this is already an accepted theory. Let us state the reasoning in the cases of these briefly.

In the case of the ear it is generally agreed that two things are necessary for the production of physical sound, viz.: A vibrating mass of matter, and an elastic medium to transmit the vibrations to the organ of hearing. There can be no physical sound in a vacuum. The undulatory motion in this case is composed of to-and-fro elements, i. e. there is alternate condensation and rarefaction among the particles of the transmitting medium. The limits of rate of vibration are about 16 per second for lowest and about 40,000 for highest. Below 16 per second the rate is so slow that the ear is not affected, and above 40,000 so fast that the ear fails to take cognizance of them. The ear is the only one of the organs of sense that is affected by aërial vibrations.

It is well known that the earliest theory of vision was the corpuscular. It was said that exceedingly small particles shot from the luminous body fell upon the eye and produced vision. Sir Isaac Newton and others were apostles of this theory. Nowadays we laugh at such an idea. Let us think of a particle sent from the sun. No matter how small it would be, it might acquire velocity enough to give it a momentum that would destroy the eye when it fell upon it. M dern science has adopted another theory known as the undulatory. This presupposes an exceedingly rare medium pervading all space and occupying the interstices between molecules and atoms. This medium is called "Ether." In the case of sound, the wave motion was the result of *mass* vibration upon the air; but in case of light, the wave motion is the result of *molecular* vibration upon this so-called ether. The elements of the undulatory motion have a transverse movement just as in the case of water waves or the waving of a field of grain. The effect produced upon the eye will vary with the number of waves entering it in a given time. It has been found by calculations based on observations made on soap bubbles, etc., that to produce the sensation we call *red*, over 400 trillions of waves must enter the eye in one second. Then as the numbers increase the impression experienced by the eye varies through all the colors of the rainbow until about 700 trillions per second are reached. Beyond that the eye fails to be affected and darkness reigns, just as it did before reaching the 400 trillions just now mentioned. Now it is well known that light is usually the result of great heat. Hence we may naturally conclude that below 400 trillions and down to an unknown limit the effect of molecular movement is to produce waves in "ether" which affect the papillae of the skin and make the sensation we call heat. When two bodies are brought near each other, if we keep in mind that the molecules of each are in motion, then that will be the hot one whose molecules are moving the faster and producing the greater number of ethereal undulations in a second. But what shall we say of the effects of rates of vibration beyond the highest extreme of impressions named light? We know not unless they are such as affect the motor nerves and the muscles and produce the sensations we ascribe to electricity. And were we inclined to materialism we might say that certain rates of inconceivable rapidity give rise to thought, spirit, life, etc. Be that as it may, let us now come back to our special organs of sense and see if we can explain the sensations of smell, taste and touch by use of molecular movements.

The story is oft recited in our books of Natural Philosophy, under the head of the wonderful divisibility of matter, how a grain of musk was kept in a room scenting it for twenty years and yet at the end of that time had lost no weight. Now this is marvelous if we suppose infinitesimal particles to be continually passing off, which falling upon the nerves of smell produce the sensation we call odor. Yes, very marvelous, that particles can be taken from a body through so many years and yet not affect the weight of that body; as much as to say that innumerable infinitesimal particles weigh nothing. We must confess we do not like to beieve such a story. Surely it is more reasonable to think that certain rates of motion among the molecules of the musk impart like rates of undulation to the "ether" and these ethereal waves reaching our nostrils produce the sensation called smell. As in the case of the eye, the senation is various according as the rate is various. Such a theory explains how the vulture scents its prey from afar. The molecules of the carrion impress their motion on the "ether" and the undulations go out and on until they fall upon and affect the keen nostrils of the bird quietly floating in the blue empyrean. Would a particle of the dead matter ever reach it, think you?

If you ask how is it the vulture and the dog and other animals can scent things imperceptible to man, we reply because they are endowed with keener sensibilities in this respect. If you ask why so many vibrations do not get mixed up and produce confusion, we ask how is it in the great orchestra that you catch the peculiar tones of each particular instrument? In music we name the quality thus distinguishing instruments *timbre;* and so there may be *timbre* in all kinds of vibrations or undulations. An odorous object loses its odor as soon as its peculiar rate of vibration is varied or lost. As in sound waves and light waves, there may be inter erence, i.e., waves which puteach other out, so to speak, so in odor waves there may be interference; thus we might explain the action of disinfectants and deodorizers. As to the limits of the rates of vibration, we know nothing.

Taste and touch are said to be produced by contact of substances with the nerves of the tongue and the skin. Yet perhaps the various peculiarities in taste and touch may be ascribed to peculiarities in rate of molecular motion. A thing is sour or sweet, bitter or nauseous or acid, according as its molecular vibrations affect the nerves of the different parts of the tongue adapted for the reception of rates producing such sensations. We have however no arguments in favor of this. As for touch, that requires contact also, just as does taste.

Let us see how we would explain the various peculiarities of surface of bodies as learned by touch.

As the finger is brought in contact with the fine point of a needle, for instance, the molecules of the papillæ in the finger end come in contact in their little oscillation with the oscillating molecules of the needle. Of course there is resistance; but as this resistance occurs at but one point, we say the needle is sharp. It is like a single man meeting a phalanx. But if the finger comes in contact with a surface and finds even resistance at all points then we say it is smooth. That is like phalanx meeting phalanx. In like manner we may explain dullness, keenness, roughness, hardness, etc.—all properties which are learned by the sense of touch.

Now, having gone thus far, let us tablulate our conclusions. Matter exists as masses, molecules, atoms and ether. These are all continually in motion. Matter which produces wave motion must move in one or other of two phases—(1) parallel to or (2) transverse to the line of direction of wave. This much established, let us say:

I. *Masses* vibrate:

(a) There is undulatory movement in *air;*
(b) Elements move parallel to line of direction of wave;
(c) Rate of vibration extending, for aught we know, from 0 to ∞ per second;
(d) Within the limits 16-40000 per second the ear is affected and we hear sound;
(e) Either side of these limits is silence so far as man is concerned.

II. *Molecules* vibrate:

(a) There is undulatory movement in *ether*;
(b) Elements move transverse to line of direction of wave;
(c) Rate of vibration extending from 0 to ∞ per second.
(d) Within the limits 400 trillions to 700 trillions per second the eye is affected and we can see light.
(e) Either side of these limits is darkness so far as man is concerned.
(f) Other senses affected in the same way are the nose, the skin and probably the muscles, but by what rates of motion we do not know.

Molecules vibrate:

(a) In contact with the tongue—Taste;
(b) In contact with the hand—Touch.

Now we hinted just now that possibly molecular vibration may result in thought. If this be true, and there is such a thing as sympathetic vibration among molecules as there is between musical strings, pendulums, etc., then is it strange that two persons should think the same thought at the same moment? Doubtless you have all had such experience. You have been surprised to hear a friend in your company speak of something which at the same moment was occupying your personal thought. Be it understood we do not say that thought can thus be explained, but the theory seems plausible to say the least of it.

To go a little further in this theorizing, if the so-called ether does pervade all space, and if vibrations or undulations once started in this ether never cease, and if the human organs of us limited beings take cognizance of occurrences around us when undulations within certain limits fall upon our senses, then an omnipotent, omnipresent being with unlimited powers could experience absolutely and really any and every occurrence that ever took place. The wide realm of ether becomes God's book of remembrance, and "the book shall be opened" to us when these limits that now enthrall us are laid aside and power and liberty is ours to go in space wheresoever we wish.

FRANKLIN'S PLACE IN SCIENCE.

Franklin's contributions to science are not limited to his electric discoveries and inventions. Out of many such that might be mentioned there are two that deserve especial attention. They are (1) the course of storms over the North American continent; (2) the effects of the Gulf Stream.

He relates the circumstances of his meteorological discovery in a letter dated February, 1749. "You desire to know my thoughts concerning the northeast storms beginning to leeward. Some years ago there was an eclipse of the moon at nine o'clock in the evening, which I intended to observe, but before night a storm blew up at northeast, and continued violent all night and all the next day, the sky thick-clouded, dark, and rainy, so that neither moon nor stars could be seen. The storm did a great deal of damage all along the coast, for we had accounts of it in the newspapers from Boston, Newport, New York, Maryland, and Virginia. But what surprised me was to find in the Boston newspaper an account of an observation of that eclipse made there, for I thought as the storm came from the northeast it must have begun sooner in Boston than with us, and consequently prevented such an observation. I wrote to my brother about it, and he informed me that the eclipse was over there an hour before the storm began. Since which I have made inquiries from time to time of travelers and of my correspondents northeastward and southwestward, and observed in the accounts in the newspapers from New England, New York, Maryland, Virginia, and South Carolina, and I find it to be a constant fact that northeast storms begin to leeward, and are often more violent there than to windward. Thus the last October storm, which was with you on the 8th, began on the 7th in Virginia and North Carolina, and was most violent there."

Of late years this observation of Franklin's has been greatly extended. It now appears that almost all the chief atmospheric disturbances of this continent pass in an easterly or northeasterly direction toward the Atlantic Ocean. Nor do they stop on gaining the sea coast. Why should they? In making their way over the ocean, though some may disappear, many reach Europe. It follows, then, that the approach of these storms, may be foretold by telegraph, and that not only in the case of the more intense atmospheric disturbances, but the coming of minor ones, such as are popularly designated waves of heat and cold, and variations of atmospheric pressure, may be predicted. The introduction of the land and ocean telegraphs for this purpose constitutes an epoch in the science of meteorology. Ships about to cross the Atlantic may be forewarned as to the weather they may expect. An exhaustive examination of the whole subject was made by Daniel Draper, director of the New York Meteorological Observatory in the Central Park, and published in his reports of that observatory for the years 1872–73.

2d. Of the Gulf Stream. The existence of this current was long ago detected by the New England fishermen, but they had no idea of its magnificent proportions, its great geographical and climatological importance. These were first brought into view by Franklin. In a memoir read at a meeting of the American Philosophical Society, December, 1785, he states that while he was concerned in the management of the American Post-office an investigation was had respecting the cause of the long voyages made by the packet ships from England. The merchant ships made much shorter ones. "There happened to be then in London a Nantucket sea-captain of my acquaintance, Captain Folger, to whom I communicated the affair. He told me that the difference was owing to this, that the Rhode Island captains were acquainted with the Gulf Stream, while those of the English packets were not. 'In crossing it we have sometimes met and spoken with those packets, who were in the middle of it, and stemming it. We have informed them that they were stemming a current that was against them to the value of three miles an hour, and advised them to cross it and get out of it.' I then observed it was a pity no notice was taken of this current upon the charts, and requested him to mark it out for me, which he readily complied with. I procured it to be engraved, by order from the General Post-office on the old chart of the Atlantic, and copies were sent down to Falmouth for the captains of the packets. Having since crossed the stream several times in passing between America and Europe, I have been attentive to sundry circumstances relating to it by which to know when one is in it. I annex hereto observations made with the thermometer in two voyages. It will appear from them that a thermometer may be a useful instrument to a navigator, since currents coming from the northward into southern seas will probably be found colder than the waters of those seas, as the currents from southern seas into northern are found warmer."

Though Franklin was not the discoverer of the Gulf Stream, he was the first to bring it prominently into notice, to cause a chart of it to be published, to detect its most important characteristic—its high temperature—to introduce the use of the thermometer, and to point out the importance of that instrument in navigation.

In the short compass of this article I have not space to relate many of his minor experiments and observations. There is, however, one that deserves to be referred to, from the influence it has had in optical science. "I took," says Franklin, "a number of little square pieces of broadcloth from a tailors pattern card, of various colors. They were black, deep blue, lighter blue, green, purple, red, yellow, white, and other colors or shades of colors. I laid them all out upon the snow on a bright sunshiny morning. In a few hours (I can not now be exact as to the time) the black, being most warmed by the sun, was sunk so low as to be below the stroke of the sun's rays; the dark blue almost as low; the lighter blue not quite so much as the dark; the other colors less as they were lighter; and the quite white remained on the surface of the snow, not having entered at all. What signifies philosophy that does not apply to some use? May we not learn from hence that black clothes are not so fit to wear in a hot, sunny climate as white ones?"

"What signifies philosophy that does not apply to some use?" That is a sentiment characteristic of Franklin, characteristic of the age in which he lived. In truth, the entire scientific and industrial progress of that century is an example of it.—DR. JOHN W. DRAPER, in *Harper's Magazine for July*.

EDUCATION.

SOME THOUGHTS ON THE PRINCIPLES OF INSTRUCTION.

BY PROF. E. C. CROSBY, KANSAS CITY, MO.

(*Concluded.*)

Says the Assistant Superintendent of the N. Y. schools (1874): "Telling pupils facts about an object without the necessary observation on their part to clearly comprehend those facts, may possibly be called teaching science, but it is neither scientific teaching nor object teaching." I do not understand how one can overlook the truth that the memorization of names of natural objects or the names of their qualities, or formulæ which express their relations, without an individual appeal first of all to their perceptive faculties, carries with it neither science nor scientific method. As the educating process simulates original investigation acquisition becomes more rapid, secure and intelligent. Strange it is that, at this late date, these principles, but little less than axiomatic, should be so disregarded, and demand explicit statement! The truth is, too many are engaged in this professional business of teaching without attempting to make it professional. A few give attention to the science of teaching; the many engage in fiction, or other diverting literature, popular science, philosophy and society. The teacher's preparation of a lesson which he is to hear recited to-morrow, has two phases; one, as to its contents and application; the other as to the exact method best calculated to arouse the mind, reach the understanding and adapt the subject at hand to the inherent and unchangeable laws of unfolding thought. This second phase of preparation is so rarely studied that he who would venture to present it at the usual teachers' institute, would suddenly find himself accused of taking up valuable time with "pet theories." May we not hope that the time is not far distant wheu a simple statement of the elemental principles of teaching, daily witnessed in the school room, will be distinguished from those baseless, ill-defined and whimsical notions which too often find vent from superheated imaginations? A single illustration: A teacher writes me concerning these views: "How can a child get an idea of an isthmus and such things without learning the definition first and then applying them?" Evidently this teacher can not understand how knowledge can be gained without beginning with a definition, mastering it, then producing an example Suppose a pail of water be carefully poured out upon the school yard. Let the pupil see the little handful of dirt surrounded by water, then give it a name. All the other geographical facts may thus be beautifully experienced and made known to the pupil, after which the separate parts may receive their several names Thus do we advance from perceptions to abstract ideas. Then follows the question, "How can children get an idea of the extent of land and water without learning the definition first?" After what has been said, this question is evidently an absurd one. Still, the question is a natural one, since the most of our school text-books, beginning as they do with definitions followed by illustrations (which are occasional), thus totally reversing the order of mental growth, are but splendid examples of human folly, which the next century will not tolerate.

The character of so-called knowledge depends largely upon the condition of mind—whether active or passive—in its acquisition. The passive state receives information from the teacher or text-book carefully cut out and clearly separated from the many things with which it was in irregular and mixed contact. The child's mental faculties, in committing this formulated knowledge to memory have been inactive save the effort to refer the several symbols back to former experiences. For a moment think of the obscurities, the opposing facts, the thread-like hints, the vague confirmations, the tentative efforts, the sudden checks, and the great discouragements, out of which have grown the finished educational products he so listlessly receives. The pupil knows nothing of those uniting, conflicting and jostling facts, but these very facts are the first things with which he will meet when he finally passes the threshhold of the school room, and in manhood's prime, he sees and feels that the school has wholly failed in teaching him the process of knowing and the methods used, by which the finished forms of knowledge became known.

In the active state of mind the pupil takes hold of the object, be it material or spiritual, and personally examines it, *i. e.* he determines (if the object be formulated knowledge) whether the relations among his experiences are like those relations asserted in the text. If material objects are under examination he feels the spring of their substance then names it "elasticity"; he breaks it then calls it brittle; his hand passes over it and he calls it rough; he lifts it, then calls it light; and generally, he first experiences, then names those experiences. Names appear after experiences, numerous illustrations after the names, and definition after those illustrations—the definition being the finished product, the sign of previous investigation. In primary instruction, at least, knowing should antedate the naming. In the active state the mind is not only discovering, but it is originally producing something, and this something is expressed in language from the securest date known to humanity. The mind is on the alert, inquisitive and determined, this active state securing many things entirely lost to the passive state. Not only does the mind fully realize the difficulties, individually knowing their exact character, but it is nerved to the effort which overcomes them. Appearance are separated from realities, and reality-relations are sworn foes to a hazy, mental sky. Orders of dependence, fallacies of position and errors in verbal statement, are originally discovered by the faculties which are necessarily sharpened and made reliant by use. In this active, investigating state of mind, comparison goes on involuntarily, the judgment is exercised in a practical way that developes it, the discriminating faculty is engaged as it must work in future years, and when the investigation is completed, the thing known is thoroughly distinguishable from every other. While presenting this line of truth (of the last half page) I am certain that its full force will be appreciated only by those persons who have, during some period of their lives, actively and persistently engaged in some experimental investigations, or made some conquests in natural history, which enables them to know that it is to have the soul tried in its search for truth. He who has never had these experiences—but which lie within the reach of every person—need not hope for the possession of an opinion upon any educational, scientific or philosophic subject deserving the respect of others.

Another phase of mental action, to which Leibnitz first drew attention, is not a little important to the teacher. Those who observe their own mental processes know that the mind frequently arrives at conclusions, and among other things, determines duties, which challenge conscious effort. "Just wait a moment, let me see," is often followed by a total inability to fix upon anything definite for the purpose. After a time the desired date, the wanted name, or the quoted sentence, flashes into the mind unbidden and unforewarned. How often we struggle to decide upon some course of action when the pros balance the cons, when the difficulties vie with the favoring circumstances, and all to no purpose. Now, throw away all care, turn the attention wholly to other subjects, and how frequently the dawn of morning brings the solution which we unhesitatingly adopt, although we are not conscious of having studied the matter at all. In his "Psychological Inquiries," Sir Benj. Brodie says: "It has often happened to me to have been occupied by a particular subject of inquiry; to have accumulated a store of facts connected with it; but to have been able to proceed no further. Then, after an interval of time, without any addition to my stock of knowledge, I found the obscurity and confusion in which the subject was originally enveloped, to have cleared away; the facts havë seemed all to settle themselves in their right places, and their mutual relations to have become apparent, although I have not been sensible of having made any distinct effort for that purpose." There is no quëstion but that much of our thinking is automatic, and it is but little less certain that no small amount is unconscious except as seen in results. It matters not whether "unconscious thinking" or "unconscious cerebration" be its technical expression, there still remains the striking fact that we are constantly using unpremeditated inferences and other like conclusions in practical life, the processes for deriving which we are profoundly ignorant. More than this, their certainty we do not for a moment call in question since all matters to which this conclusion applies, stand out in an orderly and bold relief. There is but one explanation of these phenomena possible; our minds are evolving the materials of former perceptions, balancing arguments, comparing data, and studying relations, when we do not know it, and in a similar manner to that employed when we voluntarily effect a solution of difficulties. Here, then, is the evident necessity of making all our experiences and their symbols, clear, concise and severally distinguished, since we are wholly unable, at the time in question, to supplement any deficiency by improving the perception or otherwise increasing the quantity of materials for the mind's use.

By such training, wherein the pupil knows from personal observation whereof he speaks, instead of relying upon his memory as to what some "authority" has said about it, the student is not only better enabled to encounter the problems of life and to perform its common offices not meanly but well.

> "A great problem, ever pressing upon mankind,
> Is how to discover and apply
> The immense universe of Truth unknown:
> * * * * * * * * * *
> The final end of all original research
> Is the improvement and perfection of mankind."*

"We are all blockheads in something" † has reference more to special defects and special aptitudes in the mental constitution, but beneath this striking statement there lies the peculiarity, but little less than universal, commonly called dullnes. It is clear that, to the extent that original intuitions of the pupil have been confined within narrow limits, were incomplete from any cause, or are remote in time, their symbols will possess but a scanty meaning, and be unmanageable through all the contrivances and ingenious methods which the teacher can devise, *i. e.* the pupil is dull; but, if the original experiences were ample and conclusive, were oft repeated and not distant in time while the native adhesiveness of mind is fair or good, then the symbols as used in new relations, will possess a power which makes the eye twinkle, fills the face with enthusiasm, and begets a desire for continued progress, *i. e.* the child is apt. "The new statement principle, or truth is comprehended" means, that the pupil has marshaled the symbols into intelligible order by readily supporting them with original experiences. "He does not understand" means, the pupil can not refer the symbols to their fundamental correlates, which, if they ever existed, have now faded away. We fail to reach this mind, because this mind fails to perform that act essential to every knowing. It must be noticed that these facts are not invalidated by that exceedingly important truth, that a good inheritance has everything to do with intellectual progress—"one must be well born"—as the same

* Gore.

† Senses and Intellect.—Bain.

laws of mental development obtain whether one's capacity be remarkable or inferior.

Such are the fundamental principles of mental development as I conceive them, and as such are they slowly coming into favor among those who strive to know the kind and direction of that current which forms the substratum of all our mental process. In conclusion, I know of no better instruction which will induce students to continue in improvement after graduation; none which will so much inspire the teacher to grow, after being well seated in his professional chair. Such teaching will best enable a person to withhold the expression of an opinion when he has none worth expressing; to rely somewhat upon his own observation and judgment of men and things rather than upon some "authority," to form proportionate judgments when complete ones are impossible; to reserve judgments wholly when we have not heard both sides of a controversy; to stand aloof from the acceptation of any views whose details, bearings and history have not been faithfully examined; to feel security in honest convictions when formed upon the broadest foundation within the range of the individual; to rise and resolve anew when misfortunes beset us, instead of weakening under a flood of tears; to unconditionally defend his right to reject or reserve judgment upon any beliefs which may be presented for his consideration if their data contradict the experiences of his short life time.

GEOLOGY AND MINERALOGY.

GEOLOGY AND EVOLUTION.

BY THE LATE PROF. B. F. MUDGE.

CHAPTER II.—RADIATES.

The radiates are the lowest (excepting Protozoa), of the five great sub-kingdoms of animals. They do not appear with the first traces of life in the Lower Silurian, though they are found soon afterwards. Two of the higher sub-kingdoms, the Mollusks and Articulates, appear in the Acadian and the Radiates not till the Potsdam. It is also a well settled fact that the lowest of the Radiates are not the first representatives of that sub-kingdom. Acalephs and Echinoderms appear at the opening of the Primoid, or first division of the Lower Silurian and Polyps, at the close of the Trenton, or after a period of one-fifteenth of the earth's geological history. Dana says: "If we may trust the records, Echinoderms or the highest type of Radiates were represented by species (Crystids and Crinids) long before the inferior type of Polyps existed; this can hardly be accounted for satisfactorily on the supposition that the earliest Polyps made no calcareous secretions, seeing that the ocean's waters were then eminently calcareous."*

Even the star-fishes are found nearly as early (in the Trenton) as the lowest forms. The Radiates then continue to the present time, running a parallel line of life with the Mollusks and Articulates, without ever crossing the lines of demarcation of these sub-kingdoms. The Oculina† (in Eocene) and Astreæ (in Mesozoic) Tribes did not make their appearance till long after the Polæozoic Age. So low forms of Radiates should, on all principles of development, have been seen at the dawn of life.

Though there has been a great diversity in the various phases of the Radiates, in species, genera and even orders; yet so very slight has been the advancement, that if all the changes were proved to be an outgrowth by evolution, it would not prove that a high type of animal life could be derived from a low one.

But there is one aspect of this question which appears to prove an insurmountable objection to the passage of one type into another. It relates to the mathematical structure of the Radiates. On the first appearance of the Radiates they had the parts in multiples of four; but in the Mesozoic Age the Astræ type came in with a multiple of parts in sixes. This is a mathematical change. Now, there can be no development of a triangle into a quadrilateral. When the figure ceases to have three sides it must have four. There can be no intermediate form. So of the earlier and later corals. The moment it ceases to be a radiation of fours, it becomes a radiation of sixes. The difference in structure is simply the crossing of two lines; in the one case, and of three lines, in the other. As each increases in age and maturity there is an additional cross line between each two of the first, crossing at the center, as before, and the four rays of the two lines become eight rays from the four lines in the first multiple of the old corals; and the six rays rays from the three lines become twelve rays; from the six lines in the multiples of the newer corals.

There can be, from the mathematical construction, no intermediate (evolutionary) form. The geometrical structure forbids it.

There is another plan of structure in some of the Radiates (Star-fish and Crinoids§) in which the rays are five in number or multiples of five. These are constructed on another plan, differing more from those above described than they from each other. The five rays are formed, not from lines crossing, but from five lines radiating from a common point, at equal angles. This is also a mathematical structure, and cannot be derived from either of the others any easier than a pentagon can be derived from a square or from a hexagon.

All these forms have flourished in the same waters from the Mesozoic, and most of them from the Lower Silurian Age.

The Star-fishes (Palæaster, etc.), having five rays, possess little constructive resemblance to the five-armed Pentacrinus with its thousands of plates, though

*Manual, p. 598.

†Two low forms of Corals.

§Crinoids are sometimes called "Stone Lillies," though they are not vegetable organisms.

both are of the same mathematical rank. Nor ls there, among our earlist fossils, the slightest trace that one has been derived from the other, or both from a common parentage. Both appear in the Trenton epoch with the same distinctive characteristics which they possess in any later period.

It is a principle of evolution, that the influence of climate, food and other circumstances are largely, and, in the lower forms of organism, the entire cause of the variance of structure. In these low, radiate forms "natural selection" can have no influence. With this principle before us, we would draw attention to the extremely monotonous surroundings in which the Radiates, particularly the Corals, have always existed. This can be clearly seen in the living species and genera. They are nearly all confined within the twentieth degrees of latitude on both sides of the Equator. They are most abundant in the Pacific ocean. That body of water, even more than the other tropical oceans, is noted for its uniform temperature and the uniform proportion of saline elements held in solution. Many of the Pacific islands have a maximum range of less than 15° Fahrenheit of extreme temperature in the year, and the adjoining waters have far less, at the depth of which most of the corals live. The zone of coral life is limited to one hundred feet in depth, and most genera are confined to a belt of twenty vertical feet. The variation of temperature in the year for the lower portion of this zone, is probable not over five degrees. This portion of the ocean, in which the corals live, is more uniform in its clearness and saltness than in its temporature, as when these vary the animals die. The food which most if not all of them eat is the same. Their chemical, coral, calcite structures are identical.

Now with all these extremely monotonous conditions of the coral Polyps and other Radiates, why do we find so great a variety of species, genera and even orders flourishing on the same reef? If diversified conditions, according to Prof. Darwin and his associates, give new forms, why should circumstances, such as we have described, present us with such varied ones? Or if they owe their origin to diversified conditions which are lost to our knowledge by the "imperfection of the geological records," why should not our monotonous and very uniform conditions of the age of man have reduced these numerous genera and species to a few forms?

Geologists and palæontologists have clearly settled the question that in all ages of the globe, wherever corals have existed, the conditions of the ocean, in all respects, have been the same as that in which they now exist. In collecting our fossil Radiates from the oldest strata, though in certain localities some species may predominate, we always find associated others of very different generic affinities. Yet they must, like those of the present tropics, have lived in the same water under the same climatic conditions.

Barrande classifies over thirteen hundred species of Radiates of the utmost extremes of genera from Star-fishes and Crinoids to Polyps, all gathered from the Silurian deposits. These present a close resemblance to those now living. Prof. Huxley tells us* that only one order of the corals has become extinct.

Any one looking over the beautiful volume of Zoophites, by Prof. J. D. Dana, compiled from his researches while connected with the Wilkes exploring expedition in the Pacific, will be struck even more by the diversity of conformation than by the beauty of colors in this branch of animated nature. He describes over five hundred species (we quote from memory) and saw as many more which he had not time to classify. Agassiz in 1850 estimated that there were ten thousand living species of Radiates.

THE ORIGIN AND CLASSIFICATION OF ORE DEPOSITS.†

BY PROF. J. S. NEWBERRY.

The mineral matters which have proved useful to man form three categories: first, the earthy, as gypsum, clay, marble; second, carbonaceous, as coal, lignite, petroleum; third, metallic, as iron, gold, silver.

The metals occur rarely native, oftener as ores, that is, combined with sulphur, silica, carbonic acid, etc. These form a series of deposits, of which the physical and chemical characters and history differ widely. They may be grouped into three classes, as follows:

1. *Superficial Deposits.*
2. *Stratified Deposits.*
3. *Unstratified Deposits.*

SUPERFICIAL DEPOSITS.

These include the accumulations of gold, stream-tin, platinum, gems, etc., which are obtained from the surface material, gravel, sand and clay, derived from the mechanical decomposition of rock masses through which metals or ores were sparsely distributed. Thus, gold usually occurs in small quantity in the quartz-veins of metamorphic rocks. By the erosion of these rocks, having been freed from its matrix, and that more or less perfectly removed, this gold is concentrated by a natural washing process similar to that employed by man, but on a grander scale. In the same manner, the oxide of tin, which is hard, heavy and very resistant to chemical agents, is distributed sparsely through granitic rocks or vein-stones; and where these have been eroded, the cassiterite remains in the alluvial deposits of streams, where it can be cheaply and easily collected.

Superficial deposits have probably furnished nine-tenths of all the gold that has been obtained by man, the greater part of the tin, all the platinum and its associated metals (iridium, osmium, etc.), and all the gems except the emerald, which in South America is obtained by mining. Thus, it will be seen that the surface deposits are scarcely less important, economically, than the others. The

*Lay Sermons, etc., X p. 216.

†From the *School of Mines Quarterly* for March, 1880.

superficial deposits of gold are for the most part confined to the foot-hills of mountain ranges, and are the products of the erosion effected by ages of frost, sun, rain and ice, which are continually wearing down all the more elevated portions of the earth's surface. Shore-waves also, in some instances, have worn away the rocks against which they have beaten, and have produced accumulations of *debris* that contain gold, platinum, gems, etc., in sufficient quantity to be economically worked. When a beach deposit of this kind has been raised above the sea-level, it sometimes becomes convenient and profitable mining ground. On the coast of Oregon, at and above Port Orford, the beaches now yield gold, iridium and osmium in sufficient quantity to afford profitable employment to quite a mining population; and in the Black Hills, the old Potsdam sandstone beach, formed by the beating of the Silurian sea upon cliffs of Laurentian and Huronian rocks traversed by auriferous quartz-veins, now constitutes what is there known as the "cement deposits," from which a considerable portion of the gold of this region is obtained. As has been mentioned, however, the chief supply of gold in all ages has come from the *debris* that have accumulated at the foot of mountain slopes. All mountain *chains* are composed of metamorphic rocks, and nearly all the mountain ranges of the globe are traversed by quartz-veins, in which are concentrated much of the gold that was originally finely disseminated through the sedimentary strata—conglomerates, sandstones, shales, etc.—now granites, schists and slates.

By the lateral pressure that has metamorphosed the sedimentary rocks, and produces the segregation of the quartz-veins, great folds and ridges were formed, which, rising high above the general surface, act as condensers of moisture and receive the most copious precipitation from the clouds. Hence on these mountain sides an enormous system of water-power is developed, which is spent in grinding up the rocks and transporting the *debris* to the bottom of the slope. Here it is further washed, stored, and the gold locally concentrated to form the rich "placer" diggings. As no great skill or expensive mining machinery is required to work placer deposits, every man with good health, a pick, shovel, pan and stock of provisions may go into the business. Gold washing is the simplest, as it was probably the earliest, of all mining enterprises, and has at different times employed nearly the entire population of a district or country. It is not surprising, therefore, that it has resulted in the production of an enormous quantity of gold. It is evident, however, that most of the placers of the world have been already exhausted, and while the little-known continent of Africa promises to furnish a large amount of the precious metal from its "golden sands," we can hardly expect that the production of California, Australia and New Zealand will ever be repeated in the world's history.

STRATIFIED DEPOSITS.

These may be subdivided into several groups, such as:

1. *Ore forming entire strata;* for example beds of iron ore.

2. *Ore disseminated through strata;* as copper in the schists of Mansfeldt and in the sandstones of Lake Superior.

1. *Segregated masses in strata;* as sheets of copper in the Lake Superior sandstones; balls, kidneys and sheets of clay ironstone in the shales of the Coal measures, etc.

UNSTRATIFIED DEPOSITS.

These have been divided into:

1. *Eruptive masses.*
2. *Disseminated through eruptive rocks.*
3. *Contact deposits.*
4. *Stockworks.*
5. *Fahlbands.*
6. *Impregnations.*
7. *Chambers.*
8. *Mineral veins.*

Of *Eruptive masses* of metalliferous matter I must confess myself incredulous. Examples of these are cited in the crystalline iron ores of the island of Elba, those of Nijni, Tagilsk in Russia, and in Sweden, and even the iron ore-beds of Lake Superior and Missouri. As late as 1854, this was the view taken of our crystalline iron ores by Whitney in his *Metallic Wealth;* but great advances have since been made in our knowledge of these deposits, and it is now generally conceded that all our crystalline iron ores are simply metamorphosed sedimentary beds. The evidence is accumulating that those of the old world have the same character. Professor Otto Torell, the Director of the Geological Survey of Sweden, recently told me that he had visited all but one of the iron districts of Sweden, had found that in all these the iron ores were metamorphic, and he had no doubt that those yet unexamined were of similar nature. Where metamorphic action has been peculiarly violent, the beds of iron ore have been more or less dismembered, and perhaps in some instances have been actually fused; but that any bed of iron ore is the result of an eruption from the interior of the earth, is scarcely to be credited.

The examples of the occurrence of metalliferous matter *disseminated through eruptive rocks* are by no means uncommon, and the amygdaloid traps of Lake Superior, in which the cavities formed by gases have been more or less perfectly filled with copper, suggest themselves at once. Pyrites, magnetic iron, and platinum are found sparsely diffused through trap-rocks, and are sometimes concentrated in such a way as to form valuable deposits when the trap decomposes.

Contact deposits are usually understood to be accumulations of metal or ore along the planes of contact between two strata; and the sheets and strings of copper which are concentrated at the junction of the trap and sandstone in some parts of the south shore of Lake Superior constitute illustrative examples of this class of mineral deposits. There is, however, considerable diversity in character among the deposits grouped under this head; the chief distinction being that in some cases the ore or metal has been segregated from one or the other of the strata at the time of their deposition, and in others it has come from a foreign source, and has been deposited in a more or less continuous sheet in cavities formed between the surfaces of the adjacent rock-beds. To the second of these classes would seem to belong the argentiferous ores of Leadville, Colorado. These are deposited along the plane of junction between an underlying limestone and overlying porphyry, and undoubtedly accumulated in vacant spaces formed by the solution of the limestone. These ore bodies have apparently much in common with the pockets and chambers excavated in certain limestone beds, and subsequently filled with ore, to be described farther on. The true structure of these Leadville ore bodies can, however, only be accurately learned when they shall be penetrated below the zone of unchanged sulphurets into which they will undoubtedly merge in depth.

The term *Stockwork* is applied in the old world to a mass of rock or veinstone penetrated in all directions by small intersecting sheets or veins in such a way that the whole mass is mined out. Some examples of this kind of deposit may be found in most of our mining districts; but the most important which have come under my observation are in the Oquirrh Mountains, in Utah, and at Silver Cliff, Colorado. In the first of these localities, beds of quartzite—in the second, of porphyry, have been shattered, and the crevices between the fragments have been filled with ore deposited from solution.

The name *Fahlband*, or rotten layer, originated in the silver mine of Kongs berg, in Norway, where there are parallel beds of rock impregnated with the sulphides of iron, copper, zinc, etc., which, by their decomposition, have rendered these beds so soft as easily to be removed. We occasionally meet with pyritous-rock in this country, which decomposes in the same way, but none yet known to me has any considerable importance as a metalliferous deposit.

Impregnations may be defined to be saturations of porous rock with a mineral solution or vapor from which ore has been deposited. The cinnabar which is sometimes found impregnating unchanged or metamorphosed sandstone is generally cited as affording typical examples of impregnations. In such cases, which occur in California and South America, the deposit of ore has been ascribed by some writers to vapors, by others to solution, and it would seem that the latter is the more credible theory, although the vaporization of mercury is easily effected, and, like other metals, it may be transported by steam, as we have proof at the geysers in California. More familiar and satisfactory exhibitions of impregnation are, however, afforded by the copper-bearing sandstones of Lake Superior, New Jersey and New Mexico, and the silver-bearing sandstones of Silver Reef, in Southern Utah. In all these cases, it is evident that a porous rock was once saturated with a metalliferous solution, from which, in the Lake Superior region, metallic copper was precipitated; in New Jersey and New Mexico, sulphides of copper and iron; at Silver Reef, sulphide of silver. As such repositories of the metals are easily penetrated by surface water and air, we usually find the sulphides decomposed to a considerable depth; the copper ores converted into carbonate and silicate, the sulphide of silver into the chloride.

Chambers or *pockets* in limestone form the receptacles of ore in many countries; but nowhere else are such striking examples of this class of deposit as those found in our Western mining districts. From a study of these, I have been led to add them to the catalogue of forms of ore-deposit as a distinct and important addition to those given by other writers. The distinctive characters of these accumulations of ore in chambers and galleries has not been heretofore generally recognized, and a want of information in regard to their true nature has led to much litigation and heavy losses in mining. The best examples of chamber-mines are the Eureka Consolidated, Richmond, etc., of Eureka, Nevada; the Emma, Flagstaff, Kessler, etc., in little Cottonwood District; and the Cave Mine, near Frisco, Utah. All these mines are alike in this, that the ore is found more or less completely filling irregular chambers in limestone. Some of these ore-bodies are of great size, and the aggregate product of these chamber-mines is so great as to make it necessary to record this as one of the most important forms of metalliferous deposit. From the Potts chamber in the Eureka Consolidated mine, it is said that ore of the value of a million dollars was taken, while a still larger amount was produced from the great chamber of the Emma. The origin of these chamber-deposits is, in my judgment, simply this: A stratum of limestone, more than usually soluble in atmospheric water, carrying carbonic acid—which dissolves all limestones—has at some time been honey-combed by chambers and galleries such as those which traverse the limestone plateau of Central Kentucky, of which the Mammoth Cave is an example. Subsequently this rock has been broken through and upheaved by the subterranean forces which have disturbed all our important mining districts; and through the fissures then formed mineral solutions ascended, flowing into any receptacle opened to them. Where these fissures cut an insoluble rock, they became, when filled, simply fissure-veins; but where a cavernous limestone was broken into, such caverns and galleries as were opened were more or less filled with ore. It has been suggested that the caves now holding ore were excavated by the metalliferous solution; but we find some of them entirely empty, with their sides incrusted with spar, and having all the characters of ordinary limestone caves, and even where the ore occurs, the walls of the cavity have the same character, are hard and unimpregnated with ore. Hence we must conclude that the chambers were formed, like modern caves, by surface water; and when the country was upheaved and the rock shattered, only part of them were opened, and that these received the solution and ore, while the unopened ones remained empty. The character of the ore contained in the chambers varies much, as it does in the fissure-veins of our mining districts; and the solution from which they were filled must have been different in the different localities where they occur. Argentiferous galena was evidently the most abundant ore deposited in the chambers, as it is elsewhere; but in some cases, this is associated with a large amount of iron sulphide, in others very little; while the ratio of gold to silver is inconstant, and the aggregate of both varies from nothing to several hundred dollars to the ton. The ores of Eureka run high in lead, contain much iron, and about seventy dollars in the precious metals, half gold, half silver. The ores of the Emma mine carried less iron, more lead, much more silver, less gold, and a little copper; while those of the Cave mine, at Frisco, contain no lead, much iron, a little copper, and are sometimes exceedingly rich in both silver and gold. In all the chamber-mines yet worked in this country, the ore taken out is thoroughly oxidized; but in the deeper workings of some neighboring fissure-veins, the soft, ochery ores of the chambers are found changed below into compact masses of galena and iron pyrites; the galena carrying the silver—the pyrites, the gold. Hence we may conclude that the ore originally deposited in the caves consisted of sulphides, and that, whenever these mines shall be worked below the water-level, ore of this character will be found. It should be said, however, that if the theory I have suggested of the formation of the limestone galleries and chambers is true, they will not be found to extend to so great a depth as the ore-bodies of fissure-veins, since the excavation of the limestone, if produced by atmospheric water, must be confined to the zone traversed by surface drainage. In a very dry and broken country, the line of permanent water-level may be very deep, as at Eureka, where the ore-bodies extend and are oxidized to a depth of at least 1400 feet. Such a condition of things could only exist in a very dry climate; but we have evidence that there have been great climatic changes in our western mining districts; according to King and Gilbert, two wet periods having been succeeded by two dry ones, the last prevailing now. We may therefore find chambers wrought in the limestone in a dry period below the present or normal water-level. The enormous production of gold and silver from the chamber-mines already worked proves the great importance and value of this class of deposits; and while we may predict that they will be found to be more superficial than true fissure-veins, no limit can be fixed to the future yield of mines of this character, even though they should not be profitably worked below 1500 feet from the surface.

(*To be continued.*)

GENESIS AND MODERN THOUGHT.

BY PRINCIPAL J. W. DAWSON, LL. D., MCGILL COLLEGE, MONTREAL.

Every age of the word has its own mental habits, part of which are transient, passing away with the time that gave them birth; part are permanent, and are handed down to succeeding ages. It thus happens that every great permanent monument in the world, be it a mountain, a pyramid, or a divinely inspired book, is regarded with somewhat different eyes by the successive generations of men.

The Book of Genesis is such a monument, reaching unchanged from the dawn of literature, teaching to each successive generation nearly all that it knows of the early history of the world and man. It has lasted through ages of primitive simplicity, of early civilization, of mediæval barbarism, of modern revival; and each as it passed away has glanced reverently at the old book which tells of the generations of the heavens and the earth What have the thought and the science of our age done with the old record? One thing is certain: that the present is a singular and special period, in its manner of treating ancient things. We have a way of keeping out side of us everything which went to the hearts of our fathers, of cutting everything to pieces to find what is within it, of coldly criticising objects of faith and veneration; and Genesis has received so much of this treatment that it is questionable if all even of those who have the firmest faith in revelation regard it exactly as they once did, or as their predecessors did. Perhaps it may be well to refresh our souls a little, in this matter, by a more kindly and loving glance at the Book of Genesis and its relations to our modern science and our modern lives.

Modern historical research has given us new impressions as to the great antiquity of Genesis. A book which was translated into Greek three hundred years before Christ, which was accepted alike by Samaritans and Jews as a venerable and sacred record at the time of their separation, about a thousand years before Christ, the acceptance of which can be proved from the history of Israel to have extended almost as far back as the time of the reputed author, say 1400 or 1500 years before Christ, is a very old book, if not the oldest of books. Nor has any success attended the efforts of modern criticism to show that this venerable record has been tampered with or re-edited at any later date. But the date of Moses, say 3300 years ago, does not really measure the actual antiquity of the contents of Genesis. If we were to pick out of the book all the passages that are either explicitly or by implication stated to have been revealed to or spoken by Adam, Noah, Abraham, and the other patriarchs, we should find that according to the showing of Moses himself, very much of the matter, and this of the most important, must have existed long before his time, and was merely collected and edited by him. This is the common sense aspect of that "document hypothesis" on which so much learning has been expended, and which has perplexed so many. But there are other passages, not thus indicated, which must have existed long before the time of Moses. Take, for example, the first chapter of Genesis. The contents of this chapter, relating as they do to matters which precede the advent of man, must have been just as much the result of direct inspiration as if they had contained a prophecy of the distant future. But to whom were they revealed? It may have been to Moses; but there were inspired men before Moses, and it would seem strange that this initial part of revelation should have been withheld from the generations between Adam and Moses, and more especially as the keeping of the Sabbath, which is directly based on it, was a leading institute of pre-Mosaic religion.

Recent researches in the monuments of Assyria now assure us that the ancient Chaldeans possessed this revelation. It existed among them, it is true, in a corrupt form, mixed up with idolatrous ideas; but it can be traced back as far as to the time of Abraham. The Father of the faithful may indeed, when he left Chaldea, have possessed in a written form all that part of Genesis which relates to the creation and the deluge. Thus the substance of the first chapter of Genesis probably belongs to antediluvian times, was a very old book in the days of Moses, may have been taught to him by his mother in the same form in which we now have it, and was a revelation to some antediluvian patriarch, perhaps to Adam himself.

The questions raised by the first chapter of Genesis are, however, so many and complicated that they can not profitably be entered into in a short article. The more important of them may be included in the answers to two qestions: *How* was this revelation given? and *why* was it given?

The first of these questions—the *how* of the revelation of creation—is answered by the form of the record. Its condensed, repetitive and rythmical form is evidently intended to facilitate remembrance and oral transmission. Its pictorial character and division into days suggest a succession of visions granted to the seer, and in which he saw, day by day, the work of creation proceeding from its beginning to its close. This is perhaps the most intelligible conception we can form of the nature of the revelation; and since it is the mode in which the future was presented to inspired prophets in later Biblical times, there can be no impropriety in supposing it to have been the means of communicating the knowledge of the unknown past. We may thus imagine the seer, wrapped in ecstatic vision, having his senses closed to all the impressions of the present world, and looking with inward eye at a moving procession of the events of the earth's past history, presented to him in a succession of apparent days and nights. This view may relieve us from the difficulties which have arisen from what has been called the "literal day" theory of the creative week. Just as, in the visions of later prophets, a day may stand for a year, so in this ancient prophecy, the day of the seer may be an emblematic day of vision representing one of the long days of God's creative working.

This idea of long creative periods as represented by the days of creation is, however, too important, both in its relation to science and religion, to be lightly passed over. Three affirmations may be made respecting it.

1. The doctrine of long creative periods is in harmony with the general testimony of Scripture. Many proofs of this might be given. The word "day" is used in Genesis 2 to denote the whole period of the creative work "in the day when Jehovah created the heavens and the earth." In Psalm 90, which is "a psalm of Moses," one day is said to be with the Lord as a thousand years, in reference to the period of human history, and the expression "from everlasting to everlasting," literally from "age to age," refers to the great length of the creative days. In Psalm 104, which is a poetical version of the account of creation, the tone of the references shows that the writer understood the creative work to

have occupied a long time. While the six days are said to have had an evening and morning, this is not affirmed of the seventh day, which may, therefore, in the view of the writer, be still in progress. Our Lord in his reply to the Pharisees, who accused him of working on the Sabbath—"My Father worketh hitherto, and I work"—affirms his belief that God's Sabbath lasted up to his time; and the Jews seem to have held the same opinion, since they did not object. The argument relating to the Sabbatism of God's people, in Hebrews 4, depends for its force on the idea that God's creative Sabbath is still in progress, and that Christ's Sabbatism, on which he has entered after finishing his work, is also an indefinite period. When, in Hebrews 1, Christ is said to have "made the worlds," the literal meaning is "constituted or determined the long ages of the worlds' making,"—that is, of the creative days, and the expression "eternal purpose," used of Christ in Ephesians 3:11, with reference to the creation, has the same reference. It means the purpose or design of the creative ages. The above are merely a few evidences which show that the doctrine of long creative periods was that held by Moses himself, by our Lord, and by the apostles; and after this it will be scarcely necessary to add that Augustine and other early fathers of the church understood the matter in the same way, and that many good and eminent men in later times have arrived at the same conclusion. The days of the first chapter of Genesis may be literal days of vision to the seer; but they are working days of God, and not of man; and we live in the seventh of them, which was intended to be a Sabbath of rest, but has failed of this, for the present, on account of the fall of man.

2. It may be affirmed that this doctrine of long creative days gives the only full and complete explanation of the institution and obligation of the Sabbath. If God made the world in six natural days, and rested on the seventh, then his example would have no force, unless it could be shown that, in some sense, he continues to work on six days, and rest on the seventh; but nature shows that this is not a fact, and our Lord's expression, "My Father worketh hitherto," agrees with this. Thus on the literal day theory, there would be a hidden fallacy implied in the reason annexed to the fourth commandment. But if Cod made the world in six long periods; if the seventh was not only this rest but that blessed Sabbatism in which innocent man was to enjoy perpetual happiness; if this Sabbatism was lost by the fall, and if the weekly Sabbath is a memorial of this rest lost by the fall and the hopeful sign that it is to be restored by the Savior, then we have a substantial reason for the Sabbath day, a warrant for its being placed where it is in the ten commandments, and for the great importance attached to it throughout the Old Testament. The Sabbath then becomes to us an emblem at once of the paradise lost by the fall, and of the paradise to be regained in Christ. Instead of appearing as piece of ritual misplaced in the moral law, it becomes that which gives life and significance to the whole decalogue. We have here also the true explanation of the change from the Jewish Sabbath to the Lord's day; for if the one was the reminder of the Sabbatism lost by the fall and to be restored,

the day of its restoration necessarily becomes the true Sabbath, and it needed no argument or explanation to show to the first Christians their duty in this matter. This consideration is also inplied in the argument to Hebrews 4, already referred to.

3. The long creative periods are in harmony with the records preserved in the rocks of the earth by the Creator himself. It is now generally admitted that the order of creation in the long geological epochs revealed by scientific investigation corresponds very closely with that in Genesis. Absolute agreement in details is not to be expected in the present state of knowledge; but the general sequence, in the primitive formless state, the development of the atmosphere, ocean, and dry land, the introduction first of swarms of lower marine animals, then of great reptiles (mistranslated "whales" in our version), then of mammalia, and finally of man, is the same with that in the geological record. There are, besides, many other points of coincidence which cannot be detailed here, and which give the impression that the series of pictures presented to the inspired seer must have strikingly resembled those which might be devised to illustrate our geological chronology. It is certainly a remarkable fact that the old record of Genesis should thus give us a sequence similar to that arrived at independently by science in these last days.

The second question above proposed, *why* this detailed revelation of creation should have been given, brings us to some practical applications.

1. The first great object of that "book of origins" which we have in Genesis, is to assure us of the reality of the creation, and of God as the great First Cause. The one utterance "in the beginning God created the heavens and the earth," if received in faith, is subversive of atheism, materialism, pantheism, agnosticism, and a hundred other false doctrines which have afflicted humanity. The author of Genesis does not attempt to prove this great truth, but a moment's consideration suffices to show that it needs no proof. The universe exists with all its numerous and complex machinery. Either it must have existed eternally, which is inconceivable, or it must have been produced. If produced, then it had a beginning, and could not have produced itself. But before it began there must have been a power capable of planning and producing it, and that power must have been God. The Hebrew writer calls him *Elohim*, a plural name—not merely a plural of dignity, but implying that plurality of person and action which he himself recognizes in the word of God and the Spirit of God, and implying also, that all true godhead, by whatever names recognized in different tongues, is the one God, the Creator.

2. The next object of the record of creation is to show us that all the details of nature are the work of one God, and parts of one plan. The heathen nations recognized many local and partial gods, and they deified heavenly bodies, mountains, rivers, trees, and animals. The writer of Genesis grasps the whole of this material of ancient idolatry, and shows that it is the work of one God. Thus no room is left for polytheistic views of nature, nor for that superstition which re-

gards natural phenomena as the work of malignant beings. Here, again, he lays down a principle which commends itself at once to common sense, and which all science tends to support. Nothing can be a more assured result of scientific study than the unity of plan and operation in all nature, and the folly of these superstitions which refer natural events either to chance or to the conflict of subordinate deities or demons. Thus the first chapter of Genesis, wherever received and believed, gives the death-blow to idolatry, and superstition.

3. Another great use of the record of creation is the assertion of the truth that man is the child of God, created in his image and likeness. The first question in some of our catechisms for children, "Who made you?" points to this first and primitive doctrine of religion, on which the whole relation of man to God as a moral and responsible being is built. Here, again, Genesis is in accord with the best science and philosophy. It is true that there are theorists in our time who profess to believe that the human will and reason have in some way developed themselves from the instincts of lower animals. But these men can not but feel that they are maintaining a most improbable conclusion, for it is not in accordance with natural analogy that anything should rise above its own level, that any motive-power can put forth more or other than the energy that is in it. Thus an intelligence like man can not flow upward from lower sources, but must have relation to some higher creative intelligence.

These thoughts carry us no farther than the first chapter of Genesis. The history of Eden and the Fall carry with them other truths. But I may now ask, are the truths above referred to of no practical value? They may appear too familiar to us to need to be insisted on; but the practical, and even the open denial of them by so much of the infidelity of our time, shows that they still need to be enforced, and that they really lie at the foundations of our faith. The edifice of Christianity, as it now stands forth in all the grandeur of its New Testament development, with Jesus Christ as its chief corner-stone, may well by its magnificent superstructure call our attention away from the rough stones laid down for its foundation in the old patriarchal days. But these were great and costly stones, and had they not been bedded on the rock in those primitive times, we could not now enjoy that which is built upon them.

It is well that children should be taught the noble, though child-like theology of Genesis; and well also that it should be taught in its simplicity, and without the misconceptions which have been allowed to cling around it from those darker days when the Bible was a sealed book, and when its place was taken by stories based on it, but mixed with much of superstition and misapprehension. I have found by experience that many of the objections to the truth of Genesis held as valid even by educated men, are not founded on the book itself, but on interpretations or distortions of it which have a nearer affinity with mere nursery tales than with the letter or spirit of God's word.—*Sunday School Times.*

FOSSILS IN COLORADO.

In the "Bad Lands" of Colorado over seventy new species of fossils have been discovered. They range in size from a mole to nearly that of an elephant. One of the largest species had a huge horn over each eye, while another had one on each side of the nose, and more than a foot in length resembling those on the back part of the head of the ox. A third one, a larger size than the last, had rudimental horns on the nose. Still another was about as large as the elephant. Its cheek bones were enormously expanded, and its horns were flat. A fifth species had triangular horns, turned upward. The most remarkable monsters of the past, whose existence has been disclosed by the present survey, are a series of horned species related to the rhinoceros, but possessing some features in which, according to Prof. Cope, they resembled the elephant. They stood high on the legs and had feet, but possessed osseous horns in pairs on different parts of the head.

THE MAMMOTH CAVE OF MEXICO.

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On the authority of the *Scientific American* the cave of Cacahuamilpa in Mexico is the largest in the world. P. C. Bliss, who has twice explored it, describes it as being covered with a volcanic mountain, with an extinct crater. He, with a large party provided with the best lights and scientific implements the country afforded, made a partial exploration of this wonderful cave. After descending about fifty feet they reached the floor and proceeded nearly four miles. "The roof was so high—a succession of halls—that rockets often exploded before striking it. Labyrinthine passages leave the main hall in every direction. Stalagmites and stalactites are abundant. Below this cave, at its greatest depth, are two immense caves, from each of which issues a branch of a great river. This is in many respects the most wonderful cave in the world. About the only living creature mentioned by any explorers of this cave is the bat, which is numerous.

As a striking instance of the vast beneficial results which sometimes spring from the working of one capable and active brain, it is stated that by the Bessemer steel invention, the saving to England alone in the wear of rails has been $5,500,000 per annum. The saving is expected to be $20,000,000 annually when all iron rails are changed for steel.

PHILOSOPHY.

MOTION.

BY EDGAR L. LARKIN, NEW WINDSOR, ILL.

"In the beginning there arose
The source of golden light . . .
There was then neither nonentity nor entity;
Neither atmosphere nor sky beyond . . .
. . The covered germ burst forth
By mental heat.
The ray shot across them . . .
. . There were mighty productive powers,
Nature beneath and energy above."

From Hindu Rig Veda, Ch. X, 121–129, Muller's Trans.

"All things which exist, are invisible in their primeval state; visible in their intermediate state, and again invisible in their final state." *From Hindu Bhagavad Gita, Ch. I. Thomson's Trans.*

Motion is the second mode of force displayed by matter, gravity being the first. Attraction is the only force really inherent in matter, because all other modes of energy are drawn from it by conservation. Gravity is the only force which acts when matter rests, all others being evolved from motion. Attraction is the sole motive power in nature. Gravity cannot exist separate from matter; neither can matter cease attracting, but obeys this law: Every particle of matter in existence attracts every other particle, directly as to their combined masses, and inversely as their distance squared. The first conservation of gravity is motion. Bodies attract and exert energy, but no work is performed unless the bodies move. Repulsion moves matter, but gravity brought atoms within its range. Matter in motion of necessity evolves all other modes of force. Atomic motion causes heat, electricity and light and cannot do otherwise. Matter at rest would not be endowed with any force but gravity, and other forms of energy would never develop unless it began to move. The only case in which matter would be unable to move, would be if the entire universe should be condensed into one absolutely solid globe. Molecules being as near as possible could not further approach, and gravity acting from the centre to periphery would not conserve energy, being unable to first cause motion. Matter will be eternally inert, unless separated by space sufficient to allow atoms to move. Motion once begun, all succeeding energies of nature follow, for by late philosophy all modes of force are forms of motion, heat, light, electricity and chemism are states of motion; but heat acts as repulsion, and as the only conservation of gravity is motion, and heat is motion, repulsion itself has origin in remote gravity.

Since space is necessary to matter for its evolution of power, it follows that all matter has never been solidified, else it would be solid now, being unable to separate by heat as heat is motion of atoms, and cannot begin unless molecules can move. All atoms in existence must have been once dissociated, else matter would not have full "potency" for labor in building a universe. Mathematicians say that dissociated matter is many times less dense than hydrogen, and in this condition is subject to no force save its inherent gravity. Cosmic matter destined to become a universe obeyed attraction and moved. Cosmogony must begin with gaseous matter filling infinity. Cosmical evolution cannot open with matter solid for that would not be a beginning, as condensed matter is structural and shows itself to have been wrought by force. A fluid is also complex and implies work in formation. Gas is the simplest state of matter, it is without organization, and nature begins in simplicity and proceeds to complex conditions. Gravity began motion in the gaseous mass; but motion of atoms cannot long obtain without evolving heat, and heat soon allows chemism to appear. Chemical reactions in turn augment heat, electricity develops, and the delicate motion, light, awakens from the turmoil of infinitesimal oscillation. All these, however, are modes of motion, and all derive from gravity, the primordial store of cosmic energy.

Atoms coalesced into molecules, and these into countless millions of nuclei, each one a gravitation centre. These nuclei augmented in size by drawing in adjacent matter, thus clearing space. This process went on until fluid balls separated by enormous distances condensed from the primitive cosmical mass of gas. These liquid globes were intensely hot, and all radiated light. As heat is a mode of motion, and cannot appear until motion of material atoms first begins, it is clear that primeval matter was absolutely cold; "fire-mist" never had a place in nature, for when matter is condensed by gravity and chemism, sufficient to become heated, it is no longer gas, but fluid. If heat increases from conservation of accelerated motion, the liquid reverts to gas, and at the same instant loses all its heat, only to regain it on re-condensation.

When after the lapse of vast cosmic periods, all matter had condensed into celestial spheres, some cooled to solids, others still liquid, a rigid analysis based on physics as at present understood, cannot detect the traces of action of any modes of force than these: gravity, motion, heat, chemism, electricity, magnetism and light, all modes of motion save gravity their cause. Gravity made successive conservations, erected the universe from gaseity, performed all labor, yet lost none of its vigor and still wrought with unabated energy. Motion wanes and disappears, only to reappear in other forms, as heat, light and electricity, while gravity performs all work, but does not wane and fail. Then it is inherent.

Molecular vibrations on all cosmic spheres were intense; chemism wrought with inconceivable power, evolving vast quantities of heat and light. But these atomic oscillations in time weakened, the elements locked in compounds, affinity died away, heat waned, and light vanished from smaller orbs. Indeed, waning forces must harmonize, cosmic upheavals cease, quiet ensue, heat lose its intensity, crusts solidify, air appear and water form, that two refined and inscrutable modes of motion—life and mind, might develop by undisturbed processes of evolution from inorganic atoms. Cosmical motion on each planet must nearly stop; coarse chemical reactions cease agitating and jarring the elements with unrest, before the laboratory of nature can evolve life and mind from material elements. Mind only develops in a mature state matter; material structure is most complex before it produces its most refined property. Then mind is of short duration on cosmic globes; as heat has nearly vanished before thought appears. Polar frigidity has already set in when mind awakens from unconscious atoms; molecular vibratory motion is much less rapid when mind evolves than in previous cosmical history. Coarse movement in molecules must terminate; or that excessively delicate atomic vibration causing mind could not begin. Motion is of two kinds atomic and massive. Atomic motion is known in different modes, as heat, light, electricity, chemical affinity, life and mind, and constitutes the vitality of nature. They begin in gravity, pass many mutations, culminate in the evolution of mind, wane, become quiescent, leaving lifeless and frigid worlds to roll without use in Arctic voids. All these will be dismissed and the remainder of this essay be devoted to massive motion or the movement of worlds themselves.

Massive Motion.—All cosmical bodies are in rapid motion.

Arcturus moves fifty-four, 61 Cygni, forty, and Capella, thirty miles per second. Late sidereal astronomy is rich in results relating to binary systems of revolving suns. In 1823 one component of Delta Cygni occulted the other; and in 1836, 221 Ophiuchi hid its companion. In 1839 and again in 1873 Xi Ursæ Majoris were seen as one star, between these dates, double. In 1873 the double star Omega Leonis appeared as one; they are now separating. By an astonishing generalization of modern research made possible by the spectroscope, it can be said, the universe is a Unit. All suns within range of telescopes are composed of like material, as is shown by their spectra. Then they are dominated by the same laws. Gravity and motion are omnipresent. The motion of sidereal systems is observed with the telescope; and the existence of gravity is demonstrated, for suns revolve on ellipses. When the primordial gas condensed into innumerable liquid balls, destined to be planets and suns, then to become solid, cold and dead, they moved by mutual gravity in all directions. They were of all sizes from asteroids to suns like Sirius. They had not assumed orbits, neither did the balls rotate on axes, because rotation is complex motion and cannot begin until planets commence orbital circuits. The spheres necessary to make up the universe were on hand, but the vast machine had not begun revolution. The sole motor to do the work was gravity, and its task was to project the smaller globes into orbits about the large ones.

Before seeking the processes by which wandering orbs became reduced to orderly revolution in solar systems, the laws of motion will be given.

First law. A mass of matter in space will move eternally in a straight line with uniform velocity, unless gravity turns it aside.

Second. If a mass in space be attracted by another mass, its deviation from a right line will be in the direction of the attracting body, and proportional to the mutual gravity of the two masses.

Third. Gravity and reaction caused by motion are equal and opposite.

Fourth. If a mass in space be attracted by two or more bodies simultaneously, it will not move towards either, but towards a vacant point between them, called their centre of gravity, and the motion is resultant.

Fifth. All cosmical motion is resultant, and all paths traversed are curvilinear.

The fourth and fifth are results of the three basic laws, and in a close train of reasoning might not be termed laws, but results. Their action is universal and through them orbits of planets are formed. If the primeval gas had solidified into one rigid ball, nature would have suffered eternal death, no power being able to separate the atoms. If into two balls separated by space they would have fallen on a straight line to collision and nature would have expired. If into three spheres of exactly equal mass and distance, they would have crushed together destroying all potency of matter save gravity, and nature would have terminated. But if into three globes of unequal mass, or equal in mass and separated by unequal distances, then they would inevitably form a solar system in regular revolutions. And the same results would follow with any number of spheres greater than three, lying in space within the attraction of an adjacent sun.

Centre of Gravity.—When two bodies are joined by a rigid bar, there is always a point between them where they would balance if placed on a fulcrum. In space these are removed; but an imaginary bar and fulcrum have the same property, and the point is the centre of gravity. This vacant place has the remarkable attribute, that it attracts the third body with the same force as it would if the masses of both spheres were combined there. Therefore, if two globes attract another, the latter cannot fall toward either, but will move at once toward their centre of gravity by the law of resultant motion.

Formation of Heliocentric Systems.—To begin a solar system of three members, a sun and two planets, the globe wandering in space and destined to become a sun, will be designated A, and the smaller spheres to be made planets, B and C. They form a triangle in space, and obeying the only force to which they are subject—gravity, begin draw nearer one another. Instead of moving precisely towards each other, however, each globe journeys towards the centre of gravity of the two others. C moves toward the weight centre between A and B; B falls towards the attracting point somewhere between A and C, while the great sphere A moves slowly in the direction of the gravitation centre between C.

and B. But the three balls start on straight lines; how shall they be deflected aside into curves in order to traverse orbits? The reason why seems to be the arcanum of celestial dynanics, the secret of cosmic motion, and law upon which rests the structure of the universe. The great fact is this: The centres of gravity themselves are in motion! Thus, when B moves towards the centre of attraction between A and C, this centre of gravity is all the while approaching A, because A and C are nearer together. And B started originally towards this moving point. But when B first began to move, the objective point was stationary, and afterwards began its motion. The effect on B is the key to the structure of all sidereal systems. The result is that B is turned aside from its straight path and follows a curve. Gravity has performed its most difficult task of causing worlds to move on curves, for once in motion on curved lines, orbits are inevitable. The intricate process is this: B started towards the centre of gravity of A and C on a right line, but in a unit of time this attracting centre moved a unit of space, which tended to project B on a new straight line towards it. B cannot take up this new rectilinear path, however, because it has acquired inertia of motion, tending to keep it on its original track by the first law of movement. B desires to move in two right lines at once, it can do neither, but obeying the law of resultant motion falls into a curve midway between the two straight lines. And the reason of B moving on a curve is because its objective point is moving and this deflection being a constant force, perpetually seeks to turn B into a new straight line, each infinitesimal interval of time, and a curve is made up of an infinite number of excessively short straight lines. If A and C were immovable, their centre of gravity would be stationary, and B would move towards it on a right line, but being in motion, B must traverse a curve. Finally all becomes ready for the crowning act which will instantly convert B into a planet, when it will no more wander in frigid voids, but make regular circuits in the genial rays of A. During the long journey of B a time arrives when B seeks to pass A, ignore it entirely and fly away forever by reason of inertia gained in its flight from remote space, where it first condensed. It cannot pass because at the precise moment when the radius vector of A and B or the straight line joining their centres, forms a right angle with the direction of motion of B, then B loses its relative weight, becomes balanced between the opposing forces, solar attraction and inertia of motion, and at once becomes a planet. B can neither pass by on its original path nor fall to A, but deflects into a curve, a mean between both directions, and its future motion is resultant. The orbit is a curve at the proper distance between the paths sought to be traversed under the influence of two energies, centripetal and tangential. While B was being made a planet C was passing through the same routine, and countless other heliocentric systems were in formation by the same laws. But B and C had set the sun A in new motion, hence it will continue in motion by its inertia on a curve having as a radius the distance to the nearest attracting centre, giving rise to the proper motion of the "fixed" stars daily seem from observatories. If when C approached

A and B, B in its revolution happened to lie near its line of motion so that the attraction of B on C was stronger than that of A on C, then C would fall into an orbit about B and become a satellite.

If when B sought to pass A, the inertia of B had somewhat exceeded the attraction of A, then B would move on a little further than it would have moved had its inertia been less, and the effect will be to project the planet B into an *ellipse*. If its inertia was considerably in excess, the ellipse would be very eccentric like the orbits of Mercury and Mars, or of the binary sun Gamma Virginis. If inertia and attraction were equal, then orbits would be circles; and as circular orbits are unknown, all suns drew in planets from space, and the greater the distance, of course the more rapid the flight of planets, the greater their inertia of motion, and the greater the eccentricity of their elliptical orbits. The corollary is that the cosmogony wherein rotating cosmical spheres, whether gaseous, plastic or fluid, cast off from time to time concentric rings afterwards becoming planets, has no known law of nature in its support.

Rotary motion is the most complex of massive movement. It is probable that for a long time after planets began orbital circuits, they did not turn on axes. There is a difference between the attraction of suns on the sides of planets nearest them, and on opposite sides. The excess is slight, yet in a thousand revolutions, could not fail making its power felt. The effect is to retard somewhat the progressive orbital motion of the sides next suns; and permit the external sides to move with the same velocity they had when they fell from space, and had their paths changed from tangental lines to orbital curves. This difference then in time would cause all planets to assume axial rotation. The rate of this rotary motion would not be retarded at aphelion; nor accelerated in perihelion, because the difference of solar attraction on opposite sides of planets is a constant quantity depending solely on their diameters which are invariable. When all the primordial mass of dissociated matter shall have been formed into large and small globes; and when all the great spheres shall have converted all the smaller ones into planets, and when these flying orbs shall have drawn in all stray particles of matter as meteors, then the universe will be complete, and the cosmos finished. Massive motion will be at its maximum, while atomic motion will be on the decline. Molecular activity on all suns and planets will pass culmination and run down. Light will vanish first, then heat. Elements will be locked in cold compounds and affinity cease. Electricity will be no longer dynamic but statical. Ages before this however, the vibrations life and mind will have disappeared, and at this epoch the only modes of force displayed by matter will be gravity and massive motion. Frigid globes will roll as perfectly on orbits as when mind existed to contemplate the scene. Nature will be as inert as it would have been if the cosmic gas had solidified into one inanimate ball, unless gravity can put a stop to the circuits of dead worlds. By the first law, all spheres must move forever on orbits by inertia, unless some resisting medium in space retards their motion. Gravity at this stage of the universe has one opponent,—

motion, a power derived from itself. Unless gravity can regain dominion over matter by destroying massive motion, and conserve it into atomic oscillations, lifeless worlds chained to darkened suns by attraction and inertia, will eternally make melancholy rounds, and count off useless years. A resisting medium, whatever it may be is the "potency and promise" of a new universe. Nothing else can stop stellar motion, and allow gravity to secure complete control. Gravity however regaining mastery, then planets will run down in spirals, and fall on suns; and suns will crush in ruin. Motion from being orbital and rotary, will become direct, and tumbling globes will collide with enormous momentum. Massive motion ends, when by the well-known law of conservation of force, wherein when one mode of energy vanishes, another takes its place of equal intensity, the falling motion terminates in collision, and atomic vibrations at once begin in that familiar mode of motion heat. The heat becomes most intense, acts as repulsion, separates matter into molecules and then atoms, and vanishes. Universal cold sets in at the moment when that repulsive motion—heat, ends, and gravity again begins its work, in the slow formation of another universe. Repulsion ends and gravity begins, but repulsion is motion, caused by another motion, heat, and gravity caused the heat, forming a never-ending series of mutations through which matter must pass. And in the midst of all the turbulence only one energy wrought—gravity; and all that gravity did was to cause matter to move. Then there was at the basis of all only one power, the omnipotent attraction of gravitation. The universe then is matter and motion. And the postulate of the resisting etherial medium itself is motion. All ideas derived from researches into the transmission of light, heat and chemical rays, cannot be dissociated from thoughts of motion. And the whole series of motions from the breaking up of primeval cosmic gas, is but one cycle of matter. During the entire turbulence it only assumed three forms, gaseous fluid and solid. These are deductions based upon the laws of nature as now known, but they do not seem to be very far in advance of the wisdom of our primitive Aryan ancestors at the base of the Hindu Kush, when they elaborated the remarkable sentence in the Bhagavad Gita, quoted at the beginning of this paper. In this it is said the structural or visible universe is but an intermediate state of matter, or a period during which it is in active motion.

At near 12 o'clock, June 29, a meteor, as large as a barrel, starting from the zenith, plunged down north the eastern sky and exploded with a report that reverberated for thirty seconds and shook the earth at Macon, Ga. The meteor was about five seconds falling, during which time the city was lit up as if by the electric light. The time between the disappearance of the meteor and the report, was about three minutes.

MEDICINE AND HYGIENE.

BROMIDE OF ETHYL.

R. WOOD BROWN, M. D., D. D. S., KANSAS CITY, MO.

It has long been known that certain drugs would produce insensibility, also that these drugs were often uncertain and unsafe in their action, amongst which are the poppy, mandragora, henbane, hemp, etc. Ice bags were used to produce local anæsthesia by its intense refrigerant effect while small operations were performed, such as opening felons, abcesses, etc. In China, haschisch was used to produce insensibility during operations, as far back as the year 220, the patient recovering after several days. Prior to 1846, opium was sometimes used to produce insensibility to pain, but this agent was not safe and was uncertain in its desired results; certainty and safety being essential to the successful administration of anæsthetics. The year 1846 opened a new era in the surgical world, and gave to man the priceless boon of anæsthesia. On Dec. 11th, 1846, Dr. Horace Wells, of Conn., demonstrated the practicability of anæsthesia by having a sound tooth extracted while under the influence of Nitrous Oxide Gas. Then followed the discovery of Ether anæsthesia by Dr. Morton, of Mass, Simpson of Edinburgh discovering Chloroform anæsthesia soon after. With these three anæsthetics we are all familiar, and their respective merits need not be discussed here.

The substance, Bromide of Ethyl, is a new anæsthetic, and one that bids fair to take its place amongst the others. Dr. R. J. Leois, of Phila., has used this new agent more than any one else, and with such success as to warrant its being subjected to a thorough trial. Dr. Laurence Turnbull, of Phila., has also used this agent, and he advises its use. This Bromide of Ethyl or Hydrobromic Ether, has an agreeable odor, and does not irritate the respiratory apparatus, a fact which is greatly in its favor. The nausea and vomiting which is associated with chloroform and ether, is not met with during Bromide of Ethyl anæsthesia. It is administered by the same method as chloroform and ether, but has the advantage over the latter of being non-inflammable. According to Turnbull the first drachm must be crowded upon the patient; if not, it is apt to act slowly. Every new agent in medicine should, at first, be used with care and after close study. With Bromide of Ethyl, we have a comparatively new anæsthetic, but the many successful operations under it, upon both animals and man, by men of known ability, will certainly commend it to the professions of medicine and dentistry. From its rapidity of action, and the short time in which consciousness returns; Bromide of Ethyl becomes peculiarly adapted to operations in the dental chair. Dr. J. Marion Sims narrated a case before the New York Academy of Mediicine, in which Bromide of Ethyl was used with fatal results which he lays at the door of this anæsthetic, and he expressed an opinion that Bromide of Ethyl was adapted to long operations, where there is renal disease. Dr. Sims not having investigated the matter, speaks very cautiously about this new agent. Dr. J. Ott, of New York says "that the results of his experiments with Bromide of Ethyl, show that its action is upon the gray matter of the nerves, also that it decreases the frequency of respiration by acting upon the central nervous system while increasing the pulse rate and augmenting the blood by direct influence upon the heart. Out of several hundred administrations only one case was fatal, and that occurred during an operation of great magnitude. This and the fact that the Bromide of Ethyl appears to be free from some of the objectionable characteristics of chloroform and ether, renders it worthy of thorough investigation.

CURARE AND OTHER CURES FOR HYDROPHOBIA.

There was published in *The World* a little while ago an interesting communication from Dr. John W. Green on the subject of "Hydrophobia and Woorara"—*curare*, in which he said that experiments had led him to the belief that the proper dose of the substances used hypodermically was about the thirteenth of a grain, a dose that was to be repeated often till the proper effects were produced. The woorara, he said, quieted spasms and reduced all nervous irritability, thus giving the system time to eliminate the hydrophobic virus, and as to its use, he added:

During the past three years some of the physicians connected with the German hospitals have reported a few cases where this remedy has been tried. In all but one case complete recovery ensued, and in the case that ended fatally I imagine from the report of it that the woorara was not used faithfully and understandingly. If it will, however, save 50 per cent. of those attacked, it is better than losing all of the affected. In taking account of the cases reported which I have seen, making altogether four, there has been one death. This is a percentage of 75 in favor of woorara.

More recently, an article in the same paper states that Dr. Etheridge, of Chicago, has been experimenting with curare—the secret of manufacturing which, by the way, Jovert bought last year from the Amazonas Indians—upon a hydrophobic patient, with what success we are unable to say as yet. According to the German papers, Dr. Offenberg, of Dusseldorf, has cured a woman bitten by a mad dog by a hypodermic injection of twenty centigrammes of the agent; on the other hand a Russian experiment has failed almost signally. Nine persons were bitten by a rabid wolf in the hamlet of Bogoljubow, in the Wladimir district, and were taken to the hospital, where five of them died in dreadful agony soon after their admission. The doctors resolved to try curare in the other cases. This was administered at Wladimir to the remaining four persons who had been bitten by the wolf, and they all died, but without experiencing the preliminary torture of hydrophobia. This was, of course, something gained, though not much; in the absence of any details it is impossible to say to what cause the startling result was fairly to be attributed. Two other Russian physicians, Schmidt and Ledeben, are said to have cured the case of a little girl of twelve by causing her to inhale oxygen. Our old friend, the elecampane cure—a third of an ounce stewed in a third of a pint of milk and taken fasting every other day for eighteen days—has been going the round of the press, in company with the Russian broom-seed tea cure, and the madstone, which last proved conspicuously useless in the case of the Hon. O. F. West, of Senatobia, Miss. Another treatment that has been recommended is bathing with warm vinegar and water, and then pouring a few drops of muriatic acid on the wound; still another is the application for from six to ten minutes of a sponge dipped in equal parts of chloroform and concentrated ammonia. The case of Crosse has been revived, who, having been bitten severely by a cat that died the same day from hydrophobia, cured himself by mere mental resolution after pains had reached his shoulder and spasms had shot through his throat at sight of water. The specific preventive of the pious peasants of the Ardennes is—for the dog a piece of bread blessed at mass on St. Hubert's Day; for the man wearing a ring or medal consecrated at St. Hubert's shrine. It was to this same shrine of St. Hubert in Ardennes that, as Chapella tells us, the Princess of Vandémont, having been bitten by a mad dog, did make a pilgrimage in a green carriage, dressed all in green. At the spring, having put on a green stole and listened to a chapter of the Gospel according to St. John, she drank a glass of water and returned home to live fourteen years, while two less pious friends, bitten by the same dog, died of hydrophobia. Perhaps, however, the virus was still lurking undeveloped in her system, for in June last Mr. Samuel J. Culver died at New Haven, Conn., of a bite received twenty years before, a case even more terrible in some respects than that of Frank Shields, of Bloomington, Ind., who, on the 1st of November, was put in jail to prevent him from doing violence to himself and friends. He had been roaming the woods, yelping like a hound in the chase; and on meeting teams on the road would seize the horses and bite them like a dog. He was said to have been bitten by a dog ten years ago.

M. Galtier has recently made some valuable experiments from which he draws the conclusion that the saliva of a mad dog obtained from the living animal and kept in water, continues virulent five, fourteen, and even twenty-four hours; and as the saliva of a mad dog which has succumbed to the malady or has been killed does not lose its properties through mere cooling of the body, it is important in examining the cavities of the mouth and throat after death, to guard against the possible danger of inoculation. M. Galtier tested rabbits with regard to rabies, and found it transmissible to them from the dog; also, the rabbits' rabies from them to animals of the same species. The chief symptoms are paralysis and convulsions. The animal may live from a few hours to four days after the disease has declared itself. M. Galtier found salicylic acid, injected daily under the skin, powerless to prevent the development of the disorder in rabbits.

M. Raynaud, experimenting in the same direction, ascertained the effects of inoculation of the rabbit from man in the hydrophobic state. A man in that state was brought to the Lariboisiere Hospital, having been bitten in the upper lip by a dog forty days previously. He had had the wound cauterized two hours after the accident, and had thought himself quite safe till some of the usual hydrophobic symptoms appeared. The day before his death, in a quiet interval, he yielded himself with the best grace to the experiments in inoculation which were made with his blood and his saliva. The result of inoculating the rabbit with the blood was negative (as in the great majority of previous cases of inoculation with blood of animals under rabies.) But with the saliva it was otherwise. A rabbit inoculated in the ear and abdomen, on October 11, began to show symptoms of rabies on the 15th, being much excited and damaging the walls of its cage, while it uttered loud cries and slavered at the mouth. Then it fell into collapse and died the following night. The rabbit's body was not dissected till thirty-six hours after death, and further experiment was made by taking fragments of the right and left submaxillary glands, and introducing them under the skin of two other rabbits respectively. These two rapidly succumbed, one on the fifth, the other on the sixth day (becoming visibly ill on the third); neither passed through a furious stage, however, and the predominant feature was paraplegia (a form of paralysis). The important practical result is that human saliva, such as caused rabies in the rabbit, is necessarily virulent, and would probably have corresponding effects on man; so that it should be dealt with cautiously, and that not only during the life of the person furnishing it, but in post-mortem examinations.

A STRANGE EPIDEMIC.

On the night of Tuesday, June 15, a remarkable epidemic fell upon several towns in western Massachusetts, the town of Adams suffering most severely. Out of a population of 6,000, several hundred—variously estimated from 600 to over 1,000—were prostrated by a disease resembling cholera morbus. The symptoms were first dizziness, then great nausea, followed by vomiting and prolonged purging, and in some cases delirium. A belt of country two or three miles in width and several miles long was thus afflicted, beginning at the west, the whole number of victims being estimated at from 1,200 to 1,500. No deaths are reported.

The cause of the epidemic is not known, but seems most likely to have been atmospheric. For some time the weather had been dry and hot. A heavy local rain fell during the evening, and was followed by or attended with a sudden and great lowering of the temperature. A chilly fog hung over the belt of country invaded by the disease, and a heavy "swampy" odor and taste were in the air.

The malady reached its climax in about twenty four hours. It was first sus-suspected that the water supply had been somehow poisoned, but many people who had not used the water were prostrated, while others who used it freely escaped. Adams has hitherto been regarded as an exceptionally healthy town, and the surrounding country is high and wholesome.—*Scientific American.*

PERSEVERANCE WITH THE DROWNED.

In a recent communication to the French Academy, Professor Fort asserts that he was enabled to restore to life a child three years old, by practicing artificial respiration on it four hours, commencing three hours and half after apparent death. He mentions also a case in which Dr. Fournol, of Billancourt, reanimated, in July, 1878, an apparently drowned person by four hours of artificial respiration begun one hour after the patient was taken from the water. At this season, when cases of drowning are apt to be frequent, the possible benefit that may come from a persevering effort to revive victims of drowning, should encourage friends not to despair of their resuscitation, even after several hours of seemingly fruitless labor.—*Scientific American.*

SIMPLE TEST FOR CHLORAL HYDRATE.

A new test for chloral hydrate has been devised by Frank Ogston, namely, yellow sulphide of ammonia. On adding this reagent to a solution of chloral of moderate strength there is at first no change noticed, but in a short time the colorless solution acquires an orange yellow color, and on longer standing turns brown and evolves a gas of a very disagreeable odor. Ogston's experiments show that a solution containing ten milligrammes turns brown in six hours, and gives the peculiar odor. With one milligramme the orange yellow color appears in twelve hours, but no odor. Croton chloral gives the same reaction, but chloroform, chloric ether, and formic acid do not.

BOOK NOTICES.

PREADAMITES, or a Demonstration of the Existence of Man Before Adam, together with a study of their condition, antiquity, racial affinities and progressive dispersion over the earth. By Alexander Winchell, LL. D., etc., I Vol., 8 Vo., 1880. S. C. Griggs & Co., Chicago. $3.

The origin of the human race, lost as it is in the night of antiquity, is a subject of fascinating interest, and has been a theme of speculation from the earliest ages of history. When and where did man make his first appearance on earth is an oft recurring question. From the wild inhospitable wastes of the Polar regions to the tropical luxuriance of the equator traces of the occupation of ancient inhabitants are found, from the simple flint instrument of the savage barbarian to the stately palace and temple of hewn stone of the civilized and cultivated man —their name and history alike lost and unknown. And it is not only on the surface these relics are found, but deep down in the bowels of the earth in mines and caves, and under "cubic miles of basalt," his remains have been exhumed, showing that vast geological changes have taken place on the earth since his first appearance. The difficulty of reconciling the Biblical history of man's origin with the facts of geology and the diversities of the human race has induced the theory of a preadamite race or races. Prof. Winchell, the author of several popular works on geology and kindred subjects, has collated the most trustworthy and authentic evidence on this subject and laid it before his readers in his usual pleasing and practical style, and produced a work of great interest and value to the student. The general reader will find much curious information in regard to the human race not generally accessible, but hidden away in great libraries and under a mass of Society transactions. The illustrations are good and useful, but one or two cases illustrated, we think, have been rather strained and exaggerated to make a point. L.

THE CONSERVATION OF ENERGY. Balfour Stewart, LL. D., F. R. S. Quarto pp. 27. J. Fitzgerald & Co., New York. 15c. For sale by the Kansas City Book & News Co.

"Cheap literature" has up to a very recent period been synonymous with the trash written by Ned Buntline and other writers of that ilk, but within the past two or three years the expression has been applicable to scientific, historical, and, in fact, all classes of the best works of the best authors by the best known publishers of the country.

As an example we have before us the above named work, with an appendix by Professor Alexander Bain, on the Correlation of Nervous and Mutual Forces, complete, for fifteen cents, being the seventh number of the Humboldt Library of Science. It is well printed and has all the illustrations of the original work, which could not be bought for less than about ten times as much.

Of the work itself it is unnecessary to say anything, as it is widely known as an eminently popular standard treatise by one of the most able scientific writers of the time.

WRIGHT'S NEW MAP AND GUIDE for Kansas City, Mo., Kansas City and Wyandotte, Kansas. Pocket size, folded, 50c. Published by the Kansas City Book & News Co.

This is an exceedingly complete and convenient map, one which all persons interested in the city will find quite useful, though it would have been an excellent idea to include the suburbs of Harlem, Rosedale, Armourville and River-view. It is folded and bound in paper so that it can readily be sent by mail or carried in the pocket. Mr. Wright is the pioneer in the kind of thing here for which he deserves credit.

OTHER PUBLICATIONS RECEIVED.

Programme of the International Congress to be held at Brussels, Belgium, August 22-29, translated by M. Maurice Defosse for Bureau of Education, Department of the Interior; Lists of Volumes and parts of volumes of educational periodicals wanted to complete the files in the library of the Bureau of Education, by Hon. Jno. Eaton, Commissioner; Seventh Annual Catalogue of Officers and Students of Hardin College, Mexico, Mo., 1880; Report of the Board of Commissioners of the Seventh Cincinnati Industrial Exposition, 1879, pp. 400, octavo; Prospectus of the Monte Christo Gold Mining Co., of Chicago, with charter and by-laws, 1879; The Campaign in Missouri and the Battle of Wilson's Creek, 1861, a paper read before the Missouri Historical Society of St. Louis, March, 1880, by Col. Wm. M. Wherry, U. S. A., pp. 18, 8vo.; Annual Report and Statistics of the Meteorology and Mortality of the City of Oakland, Cal., for the year 1879, J. B. Trembley, M. D., pp. 14, 8vo.; The School Bulletin Year Book, for 1880, an Educational Directory of the State of New York, compiled by C. W. Bardeen, with map of the State. Davis, Bardeen & Co., Syracuse, New York, $1; The *Graphic*, Eureka, Kansas, weekly, H. H. Clark, editor, $1.50 per annum; The *Jewell County Review*, Mankato, Kansas, weekly, L. D. Reynolds, $1 per annum; The *Cotton Planters' and Manufacturer's Journal*, Little Rock, Ark., monthly, Coleman & Co., $1; The Wilmington, Ohio, *Journal*, weekly, Vernon & Tudor, $1.50 per annum.

SCIENTIFIC MISCELLANY.

THE SAN JUAN REGION.

Leaving the Narrow Gauge at Alamosa, the terminus of the main line of the Denver and Rio Grande road, the tourist or miner can mount a "burro" or take a stage to the various camps of Silver San Juan—to Lake City, 115 miles, or to Silverton, 140 miles, visiting Rio Grande, sixty-nine miles distant, by the way, and thence pursue his way across the Range to the Dolores River country, fifty or more miles beyond Silverton, and northward to Ouray.

These names are all familiar to Colorado miners, and they have proved very attractive. A little less than a year ago, carbonate ore was discovered on the Dolores River, and that section has ever since been the goal of numerous prospectors. Poughkeepsie Gulch, Rico, the San Miguel, Animas Forks, and Mineral Point are also more or less famous; and the outlook for the coming year is that the narrow-gauge coaches of the Denver & Rio Grande will be taxed to their utmost in carrying prospectors and capitalists to the prospectively rich regions of southwestern Colorado.

"The formation containing the lodes, and holding the greatest portion of the mineral belt," says the Denver *News*, "is in and around San Juan County, and the formation, generally speaking, is eruptive or volcanic porphyry, with granite and occasionally sandstone and trachyte, as the country rock and vein walls. Silver predominates as a galena ore, carrying from ten to twenty per cent. of lead, and ranging from fifty ounces upward to the ton. Gray copper, ruby silver, wire and native silver, carbonates, sulphurets, chlorides and free gold are the other ores found throughout the district."

The Summit district, in Rio Grande County, is exclusively gold, free and in decomposed quartz, with stamps as the only process of treatment. Henson Creek and Sheffer's Basin, in Hinsdale County, Uncompahgre and Poughkeepsie districts, with Mount Sneffles and a portion of the Upper Miguel and Silver Mountain, in Ouray County, forming a regular belt of mineral, have a high-grade gray copper ore, with ruby, wire, native and brittle silver, carrying little lead, and hence suitable for the leaching, or lixiviation process. The veins on Mounts Galena, Tower, Hazelton, Aulton, King Solomon and Kendall, in San Juan County, surrounding Silverton, are essentially galena ore bearing, averaging as much as fifty per cent. in lead. These ores are treated by reverberatory roasters and cupola blast furnaces. The main stream of the San Miguel, in Ouray County, and the La Plata River, in La Plata County, are altogether placer and gulch diggings, mined by sluice booming and hydraulics. The latest discovery on the Dolores, in Ouray County, properly called the Pioneer district, for it was worked years before the most of the San Juan Region was known, is now exclusively a carbonate camp, with the same formation and general characteristics as Leadville, except, perhaps, less lead, more iron, and an altitude 3,000 feet lower. The notable districts now are comparatively scattered, and there are forty miles square webbed with mineral veins, all, as yet, barely prospected.

As nearly as can be estimated, the ore product of the mines in this district, last year, amounted to 9,075 tons, or $1,400,000. The present year a very great increase is confidently predicted. Smelting furnaces and reduction and sampling works will be erected at many points. The hundred or more mines discovered last year will be developed and worked this year. Capital is already seeking investment here, and the outlook for activity all along the line could not be better.

SILVER CLIFF AND ROSITA.

The tourist will do well to make a visit to the famous mining camps, Rosita and Silver Cliff, before leaving this section of Colorado. Stages from Cañon City make daily trips to these points and enable sight-seers to see the two most populous as well as richest mining camps of southern Colorado. Rosita is eight miles beyond Silver Cliff and two years ago was the scene of a great rush. It holds its way with most Colorado camps still, but is left behind in the race by its more prosperous neighbor. Silver Cliff is a city of 5,000 people now, and confidently anticipates a population of double that number within six months.

The most famous mines of this section are the Bull Domingo, Bassick, Silver Cliff, West Mountain, Plata Verde and Racine Boy. The first named is a Rosita mine and experts estimate the quantity of ore now in sight at $1,249,-440. The Bassick mine has been shipping $2,000 worth of ore daily to the Silver Cliff sampling works, and continues to show up fine bodies of high grade ore. The Bassick is believed by many miners to be one of the big bonanzas of the world. The Racine Boy, at Silver Cliff, is operating two tunnels, and its development promises to show better bodies of ore as the work continues. The company has taken more than $100,000 from the big tunnel. What is true of the above mines, is true of a hundred others in a limited degree. Some rich gold discovered have been recently made in several mining camps adjacent to Silver Cliff, and the little county of Custer, in which these mines are located, bids fair to become a rival even to Lake County.

THE VESUVIUS RAILWAY.

The first public trial of this remarkable line took place on the 6th inst. The time of ascent requires only eight minutes, on foot it takes an hour and a half. A correspondent of *The Times*, who was present on the occasion, says:—"It must be admitted that on this, the first public experiment, the boldest among the many present confessed the necessity of screwing their courage up to the sticking po nt before making the railway journey along a road steep as a ladder or a fire-escape and 860 metres in length; but as regards danger, it is reduced to a minimum. It is not a train in which one travels, but a single carriage, carrying ten persons only, and as the ascending carriage starts, another, counterbalancing it, comes down from the summit, the weight of each being five tons. The carriages are so constructed that, rising or descending, the passenger sits on a level plane, and whatever emotion or hesitation may be felt on starting, changes, before one has risen twenty metres, into a feeling of perfect security. The motion also is very gentle, and the effect is magnificent, if not, indeed, grandly awful, as, when hanging midway against the side of the cone, one looks, from the window directly upwards or downwards along the line, which, its slight incline alone excepted, is perfectly perpendicular. Dismounting at a little station at the summit, one can scarcely be said to clamber to the edge of the crater, for the company have cut a convenient winding path, up which all, except the aged, heavy or feeble, can walk with ease. The upper station was gaily decked with a trophy of flags. Flags of all nations waved along each side of the line, and, after descending again to the base of the cone, we sat down, 120 in number, to a splendid banquet, spread in a spacious and well-appointed restaurant, established in a kind of Pompeian villa."—*Iron.*

EDITORIAL NOTES.

DURING a brief visit to Chicago we availed ourself of a long-standing invitation to visit the University and especially Dearborn Observatory, where we found Professor Hughes and Mr. S. W. Burnham, the former teacher of Natural Science, and the latter so well known among astronomers as the discoverer of a great number of double stars.

The University of Chicago is a handsome building, with ample grounds, well arranged and equipped for educational purposes and possessed of a faculty of finely educated and liberal minded men who are doing excellent work in their respective departments.

The observatory is a model structure and has the good fortune to own one of the largest telescopes in the world, one originally constructed for the State of Mississippi, which, owing to the outbreak of the late war was unable to take it. Mr. Burnham has the use of this instrument and is pushing his observations and studies with great zeal and industry.

He paid a handsome compliment to Professor Pritchett of Glasgow, Mo., and was enthusiastic in his praises of the atmosphere of our western or central region for astronomical purposes.

THE STEAMER Dessouk, with the obelisk on board, which was presented to the city of New York by the Egyptian Government, sailed from Alexandria June 12th, and from Gibraltar, June 26th, for the United States.

THE HEAT of the past few days has been quite universal.

At Albany, at seven o'clock on the 26th ult. the thermometer recorded 79 degrees in the shade. At Washington it recorded 80, and at New Orleans, where one would naturally expect the temperature to be excessively warm, it registered but 77 degrees in the shade. At Duluth it was 60, at Philadelphia it reached 71, and at San Francisco it only mounted among the fifties, while the city and bay were veiled by a fog. At St. Louis it was 75°, at Yankton 78°, at Chicago 77° and at Kansas City 70°.

THE *Lancet* says it would be difficult to point to a more probable source of infection in the search for causes of disease in private families than the houses where the practical work of dress-making is performed. It recommends, therefore, the erection of public work-rooms, well-arranged and under proper supervision, to which the poor might bring their work and finish it in cleanliness, comfort and peace.

THE SIGNAL Service Department at Washington has established a central meteorological station at Washburne College, near Topeka, with auxiliary stations in each county in Kansas. The instruments are in place and the observations begin July 1st. Professor J. Lovewell will have charge of the work.

THE QUESTION of dispelling or illuminating fogs requires the attention of physicists and meteorologists at once. The number of terrible accidents occuring lately from collisions in fog-banks is discreditable to modern science.

DIPHTHERIA is raging with fearful fatality in Russia. Out of 46,136 persons attacked 18,698 deaths ensued.

A REPORT upon the paper carbon horseshoe lamp constructed by Mr. Edison, prepared and contributed to Van Nostrand's *Engineer-*

ing Magazine for July 1880, closes as follows: "It is evident Mr. Edison's lamp, as now made, does not escape the enormous loss which has heretofore been encountered by all forms of incandescent electric lamps."

PROFESSORS Edward M. Shepard, of Drury College, Springfield, Mo., and Charles H. Ford, of the State Normal School, Kirksville, Mo., have decided to hold a Summer School of Biology at Springfield, Mo., beginning the first day of July, and continuing not less than six weeks.

Two Lectures will be given each day, accompanied by laboratory work in dissection, use of microscope, etc. Occasional excursions will be made into the surrounding country and on the James River, which will afford fine opportunities for scientific research.

By the kindness of the authorities of Drury College, the College building—including lecture rooms, laboratory and boarding hall, as well as the library, apparatus and collections—will be at the service of the students. Access will also be given to the collections of the Packard Natural History Society, and to the private libraries of the instructors.

Mr. Shepard will instruct in the departments of Invertebrate Zoology and Cryptogamic Botany.

Mr. Ford will have charge of Vetebrate and Phænogamic Botany.

PROFESSORS S. H. Trowbridge, H. S. Pritchett and T. Berry Smith have inaugurated a Summer School of Science in Pritchett Institute, Glasgow, Mo. The object of this School is to afford students of the State an opportunity of studying science by observing some of the facts and phenomena on which it rests, and by a free use of illustrative specimens and apparatus. The school commenced on Monday, June 28th, and continues six weeks. It will embrace three departments, viz: 1, Geology and Natural History; 2, Astronomy; 3, Chemistry and Physics.

THE reader who is curious to obtain an inside view of Prince Bismarck's character as the genius of Statecraft, will find much to interest him in a paper contributed to the *North American Review* for July, by the great Chancellor's Boswell, Moritz Busch, entitled, "Bismarck as a Friend of America and as a Statesman." Other articles in the same number of the Review are "Canada and the United States," by Prof. Goldwin Smith: "The Exodus of Israel," by President S. C. Bartlett,—a defense of the Pentateuchal account in the light of modern research; "The English House of Lords," by J. E. Thorold Rogers, M. P.; "The Ethics of Sex," by Miss M. A. Hardaker,—a calm, philosophical study of the woman question; "The Panama Canal," by Count de Lesseps; and "Profligacy in Fiction," by A. K. Fiske.

THE leading article in the Boston *Journal of Chemistry* for June is entitled "Shall we bolt our food," and is a digest of the views of several physiologists, who argue in favor of swallowing our food whole, and in opposition to the long-trusted theory of eating slowly and chewing the food thoroughly; on the ground that the finely masticated food passes out of the stomach before it is fully prepared for the next process in digestion.

THE "Studies in Comparative Phrenology," found in the *Phrenological Journal* for July are very interesting and will repay careful reading.

AN elaborate article in the London *Telegraphic Journal* upon the value and importance of "Varley's Electric Time Ball" on the dome of the West Strand telegraph office prompts the enquiry what has become of the project of establishing a similar signal at the Kansas City Union Depot, as proposed by Prof. C. W. Pritchett, of the Morrison Observatory, last spring.

THE *Gardeners' Monthly*, edited by the well-known scientist, Thomas Meehan, is a periodical that every professional gardener and agriculturist needs, and all amateurs will find it of the greatest value.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

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GEOLOGY AND MINERALOGY.

GEOLOGY AND EVOLUTION.

BY THE LATE PROF. B. F. MUDGE.

CHAPTER III.—MOLLUSKS.

In the examination of the sub-kingdom of Mollusks, we find at the beginning nearly all ranks of groups fully represented. In the address of Vice-President J. W. Dawson, before the American Association, in 1875, he says: "Here then meets us at the outset the fact that in as far as the groups of annulose and molluscous animals are concerned, we can trace these back no farther than in a period in which they appear already very highly advanced, much specialized and represented by many diverse forms." Development or evolution, if a law of nature, should begin with the lowest of each sub-kingdom, and symmetrically advance to the highest. But the first Mollusks of even below the Silurian, are associated with Pteropods, which are (next to the Cephalopods) the highest order; and the latter soon appear. In addition, some of the lowest forms are late in coming forward on the stage of life. Some genera come and retire in a short period of time; others, like the Lingula, are seen early in the Lower Silurian, both in Europe and America, and are in existence in our present seas.

The most noticeable feature of this question of development is, that in nearly all cases where a definite progression is claimed, either in this sub-kingdom or any other, the species are represented by few specimens. Where numerous fossils of one species are found, either no evolution is seen, or the progress is so slow and slight that it proves so little as to have scarcely any weight in the discussion. Let us notice a few in detail.

Take one of the lowest, *Fusulina Cylindrica*, a small Rhizopod, in appearance like a grain of barley. It has a wide geographical as well as geological range. It is found in Europe, Asia and America, and from the Sub-carboniferous through the Permian, or in one-eighth of the *fossiliferous* age of the globe. It has a series of coils, like the Nautilus, with septa, or partitions, extending part way across the chamber, instead of wholly, as in the Nautilus and Ammonite.* These chambered shells are far higher in rank than this little half chambered shell. Yet during all its long geological life of six million years,† it never extended its partition entirely from coil to coil, to take the first step toward a higher form.

Take another characteristic species of the Carboniferous Age, of a higher order—*Athyris Subtilita*. It is exceedingly abundant in America, as well as in Europe, in all the carboniferous deposits. It also, unlike the *Fusulina*, has a tendency to sport under a variety of forms (hence its name), but always keeps within a prescribed boundary. Thus a quantity of specimens from the same locality, say the lowest, will vary so much, that the extremes being taken, without reference to the intermediate forms, two species would be recognized. Another quantity from a different region, and entirely different horizon, perhaps the highest, will disclose a like variable appearance, but in no greater degree. If the two collections are then placed side by side, one cannot be distinguished from the other. No two will be found alike, but all are *Athyris Subtilita*. Though variability is always a feature of this shell, it constantly retains its specific characteristics, within a narrow circle of vitality, from the lowest Carboniferous through the Permian.

In contrast, as far as versatility is concerned, and of persistence in details, we may take another common carboniferous species, viz., *Productus semi-Reticulatus*. It, like the others, runs through that entire geological age. It derives its name from the reticulation, or crossing lines, of the outer surface of the upper half of the ventral valve of the shell.‡ So little change occurs in its structure, during all its existence, one-eighth of the geological history, that the simple small furrows did not disappear from one half, or extend over the other half, in millions of generations. Is evolution a law of natural history when it is so persistent in small things?

Passing to another order of Mollusks, let us examine the *Ostrea*, or oysters. They date from the Paleozoic§ Age. Like the *Athyris Subtilita*, the whole genus is noted for its sporting variation of outline, and for an equal adherence to its original characteristic phases. Its peculiar foliated texture of shell, too well known to need description, the irregularity in shape and curvature of the valves, and the

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*See note on page 21.

‡See Fig. Dana's Manual.

*Paleozoic includes the three divisions, Silurian, Devonian, and Carboniferous.

§See Fig. Dana's Manual.

simple muscle which binds them together, are the characteristics. They are found now living in nearly all parts of shoal ocean, outside of the Frigid Zones. But a short notice of a simple species will better illustrate the stable nature of this genus. Take *Ostrea Congesta.* It lived through nearly the whole of the Cretaceous Age. It occurs on both sides of the Rocky Mountains over wide areas. It is collected in Kansas over ten thousand square miles, and I have seen fifty thousand on a square acre. While there is in shape as great a variety in any one thousand, as in the living Virginia oyster, still no greater variance can be traced in specimens from the lowest to the highest geological horizon, or from the beds in Texas, New Mexico, or Nebraska. Where so little change occurs, and such constancy of species is seen, what support is there for Lamarck's conjecture that man may have sprung from an oyster? Yet oysters have been known to vary, at least in size, by varying circumstances. A most interesting and remarkable illustration, on a large scale, of the effect of a change of circumstances, in controlling the vitality of Mollusks, has taken place in the north of Europe.

When man in the old stone age first dwelt on the shores of the Baltic Sea, it was a large open bay of the ocean, covering nearly twice as many square miles as at present. It opened into the Arctic ocean on the north, Norway and Sweden being an island. Denmark was then represented by a few low islands, and the salt waters of the ocean had free access. The Baltic was then in reality a part of the ocean, and animals which could live in one, existed in the other. But early in man's history this part of Europe began very slowly to rise, till its pre ent position is about two hundred feet higher than when it began to ascend. This elevation united the islands of Denmark, forming that peninsula, and joined it to the continent. The southern shores of Norway and Sweden encroached on the outlet, and the Baltic became a land-locked sea, smaller and less deep than before. Formerly, as now, it received the drainage of that portion of Europe; and those large rivers, Oder, Vistula, Duna, and others, carried so much fresh water into it, that animals which required water of the full ocean saltness, suffered, and finally disappeared. As the geographical change was very gradual, so also was the change in the Mollusks. The common oyster (*ostrea edulis*), now so abundant in the ocean on the shores of the North Sea, flourished equally well, before this elevation, on what is now the shores of the Baltic. By the quantity of fresh water poured into this inland sea, these oysters became stunted and dwarfed to one-third of their natural size, then diminished in numbers and became locally extinct. The whole history of this interesting change in animal life can be studied in the remains of the "kitchen middens," or "refuse heaps," on the coast of Sweden. There the old pre-historic inhabitants at first ate the full sized oyster, and continued to use it as an article of food till it disappeared, near the close of the elevation, and then were obliged to procure a substitute. This process of local extermination occupied many thousands of years. During all this dwarfing in the oyster, it lost none of its characteristics as a species, and showed no tendency to diverge into any other variety, but simply died out. As degradation to a lower character is a part of the theory of evolution, here is just the change of surroundings which should have given us a lower species.

The same modification and local extinction took place in the eatable cockle, mussel and periwinkle (*Cardium edule*, *Mytilus edulis*, *and Littorina Littoria*), which are also found in the "refuse heaps." They, as well as many species not eaten by man, and now flourishing in the adjacent North Sea, became stunted and disappeared in the same gradual manner, without any specific change. Others more hardy are now living in both seas, but are much smaller in the Baltic than in the North sea, yet showing no loss of characteristic traits.

If we examine the Ammonites, we shall find a tribe which varies in its characteristics more, probably, than any other mollusk. They appear in the Devonian, and continue to the Eocene Tertiary, or during one-half of the whole geological period. They are represented by more than one thousand species. This great number presents quite a diversity, showing that the family possessed what is called a protean tendency in size and shape. It is claimed by some paleontologists, with some show of facts, that many of these species run into, or are derived from others. It is even contended that genera of the family can be traced from one to another by gradual variation. This is not yet admitted by our leading authorities in paleontology. Notwithstanding the marked variance of different species, they are all distinguished by common characteristics, viz., a chambered shell with sutural or interlacing partitions, and a siphuncle passing, not near the center, but along the side of the chamber, through the partition. The variations of structure are always confined within the circle of these conditions. The thousand species are during this long range of time not only Cephalopods, but restricted to the narrow limits of their family features without crossing its boundaries. There is no proof that they were derived from a lower type or passed to a higher.

Now if we allow the utmost claim of the evolutionists, that all these species and genera sprang from one common stock, even then we may say, the change is too small relatively, to show that any truly low type evolves to a higher. Had they continued to live to the present age, would they, at the same rate of progress, have attained the structure of a low crustacean? The great variety of forms are in most cases no increase in rank, but simply in diversity from those associated in the same seas.

The firm continuance of general features, from the Devonian to the Tertiary, is much stronger against a general system of evolution than the variance of form is in its favor. Is it not more remarkable that during so long a geological term, in all parts of the world, under so great a diversity of circumstances, that there should have been so little change rather than so much.

The Nautilus family presents another somewhat similar history. It appears in the Lower Silurian Age and continues to the present day, through almost the whole of earth's geological history. The Nautilus resembles the Ammonite, but is distinguished from it by the smooth curved line of its partitions (not interlacing) with the siphon passing through them in the center, or nearly so. These characteristics the Nautilus retains during its geological life. It is claimed that the early species are more embryonic than the later, yet the normal plan is followed so closely in the five hundred species, that the real advance in organic structure is very slight. Most of the species show merely a diverse relation of parts without any relative advance in rank. Notwithstanding the range of earth's conditions has been so extreme that nearly the whole of the Nautili have disappeared, and only three or four species are preserved in our oceans, yet the strange adherence to the normal structure has been such that they have never diverged to the Pteropods or Acephals on the one hand, or developed into a crustacean on the other.

We might multiply facts to show the essential uniformity of Mollusks, but it is enough to state that Murchison, in his "Siluria," gives the following existing genera, viz.: Avicula, Mytilis, Chiton, Natica, Patella, Trochus, Discina, Orbicula, Lingula, Rhynchonella, and Nautilus, as Silurian, which have continued through all geological formations, and are now living in our oceans. The expression of "all-time genus"* Nautilus, which Dana has given to one, may be considered as applicable to all.

The examples frequently quoted, of change of species, without considering that the genera to which they belong is permanently inflexible, is a strong argument against evolution. Thus, Shaler, in the "Geological Report of Kentucky for 1876," has given a very careful and critical memoir on the question of the variation of the more flexible or protean species, with tables of measurements and illustrations by plates, in addition to detailed remarks. One of his examples (*Orthis accidentalis*) shows a variation in the proportion of length to width of forty-five per cent. This would be a strong proof of a tendency to outgrow the normal characters of the shell, did we not know that the genus *Orthis* began at the opening of the Silurian and ended with the close of the Carboniferous, covering three-fourths of our geological time. This shows that while a species may be quite variable within its circle of vitality, that variability may be clearly restricted in generic features.

A similar instance is seen in the fresh water *Planorbis*. Hilgendorf has described a case, where he collected ten graduated varieties of *Planorbis multiformis*, from the beds of a deposit in Switzerland. Yet the genus *Planorbis* has lived from the Jurassic to the present time. The multiform variations of this species, like *Orthis occidentalis* and many others, did not extend to the generic features.

These cases of a tendency to vary in structure (protean species) are frequently quoted in proof of evolution. Although a species is variable, but the genus to which it belongs is unchanged during long geological eras, the real evidence must be considered as bearing against evolution.

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*Manual, p. 598.

THE ORIGIN AND CLASSIFICATION OF ORE DEPOSITS.*

BY PROF. J. S. NEWBERRY.

(*Concluded.*)

Mineral Veins. Some writers on economic geology—Werner, Von Cotta and Von Groddeck, for example—enumerate many different kinds of mineral veins; but disregarding the local characters which all ore-deposits exhibit and the hybrids which are formed by the blending of two distinct forms, not of uncommon occurrence, I agree with Whitney in recognizing but three distinct classes, namely:

1. *Gash-veins.*
2. *Segregated veins.*
3. *Fissure-veins.*

Gash-veins may be defined to be those which occur only in limestone, are confined to a single stratum formation, and hence are limited in extent, both laterally and vertically. Typical examples of gash-veins are furnished by our lead deposits of the Mississippi valley. These occur at three horizons, namely, about Galena, in the Galena limestone, belonging to the Trenton group; in Southeastern Missouri, where the Mine La Motte is located, in the equivalent of the Calciferous sand-rock; and in Southwestern Missouri, where the mines of lead and zinc occur in the Lower Carboniferous limestone. The origin of deposits of this character is apparently quite simple. The cavities which form the repositories of the ore are generally the cleavage-planes or joints of a soluble limestone rock that become channels through which surface-water charged with carbonic acid flows in a system of subterranean drainage. We usually find two sets of joints approximately at right angles to each other, and vertical if the rocks are horizontal. To form gash-veins, one or both of these sets of vertical joints are locally enlarged into lenticular cavities or "gashes," whence the name; but sometimes caves of considerable size, irregular pockets, and vertical or horizontal galleries are formed. These are subsequently lined or filled with ore, sulphides of lead, zinc, and iron, originally disseminated through the limestone, and leached out of it by water, which saturates and traverses all rocks in a humid climate. The solution thus formed reaching a cavity has, by evaporation, deposited the ore as a lining to that cavity; narrow fissures being perhaps filled, walls of larger cavities coated with stalactites depending from the roof, etc. Subsequent solution has sometimes widened a fissure once filled with ore, leaving the ore-body as a central partition, a curtain more or less complete hanging from the roof, or a mass of fragments mingled with infiltrated sand and clay in the floor of the cave. In Southwestern Missouri, the Carboniferous limestone contains layers of chert, which are insoluble, and which sometimes form horizontal floors or ceilings of caverns. These,

*From the School of Mines Quarterly, March, 1880.

breaking down by their own weight, have formed masses of *debris*, cemented together by the ore, which has thus acquired its peculiar brecciated character.

From the description of gash-veins given above, it will be seen that they have much in common with the pockets and chambers previously described; but there is this important difference, that the ore filling the gashes and irregular chambers of the lead-bearing limestones is indigenous, having been derived from the leaching of the adjacent rock, while in the chamber-mines of the West the ore is exotic, having been brought up through fissures from a remote source below; so that, while in physical characters the western gold and silver-bearing ore-chambers resemble gash-veins, they are really but appendages to true fissure-veins, and only occur in a country that has been much broken by subterranean forces.

Segregated veins are confined to metamorphic rocks, are conformable with their bedding, and are limited in extent both laterally and vertically. Their ore-bodies form lenticular masses of greater or less dimensions, of which the material is chiefly quartz, which has segregated (that is, separated) from the surrounding rock. The quartz-veins so abundant in the gneisses and schists of Canada, New England and the Alleghany belt are all examples of this class of ore-deposits. The most important constituent of segregated veins is gold, which here seems to have been mechanically dispersed throughout sedimentary rocks, and to have been concentrated with the quartz in the process of metamorphism to which they have been subjected. With the gold we always find iron pyrites, sometimes chalco-pyrite, and the latter occasionally in sufficient quantity to be worth working. From these remarks it may be inferred that segregated veins have no deep-seated origin, are less continuous in depth and laterally than fissure-veins, and therefore constitute a less permanent foundation for mining enterprises. It may be said, however, that some of them are of enormous dimensions, and that they not unfrequently occur in succession, or so approximate that they are equivalent to a continuous mineral deposit.

Fissure-veins occupy crevices which have been formed by subterranean forces and have been filled from a foreign source. They traverse indiscriminately all kinds of rock, and are without definite limits laterally or vertically. They have as characteristic features smooth, striated, sometimes polished, walls (slickensides) clay gouges or selvages on one or both sides, and a banded or ribboned structure throughout. The veinstone is usually quartz, and the constituents include the ores of all the metals. The mode of formation of fissure-veins is apparently this: In the regions where the earth's crust is broken up in the adjustment of the cold and hard exterior to the cooling and shrinking nucleus, cracks are formed, often miles in extent, along which the rocks suffer displacement, sliding on each other to form what are known as "faults." As the planes of these faults are more or less undulated, with displacement the bearing is upon the projecting bosses of each side. Between these, open fissures are left of greater or less dimensions. These reach down to a heated zone, and form the conduits through which thermal waters flow to the surface. Such waters coming in different localities from different depths, and leaching rocks of various composition under great pressure and high temperature, having great solvent power, become loaded with various mineral matters. As they rise to the surface, the pressure and temperature are reduced, and the materials held in solution are deposited to line and perhaps ultimately fill the channels through which they flow. This theory of the filling of mineral veins—that is, by precipitation from heated chemical solutions coming from below—is supported by such an array of facts that it must be accepted by all who will make a careful and unprejudiced study of the subject. It is true, however, that various other theories have been, at one time or another, put forth for the explanation of the phenomena. Among these, a few deserve a passing notice. They are:

1. *The theory of igneous ejection*, according to which the matter filling mineral veins has been erupted like that of trap dikes, and such veins as those of Lake Superior containing metallic copper have been suggested as affording good examples. But here we find metallic copper and silver associated, and each chemically pure; whereas if they had ever been fused, they certainly would have formed an alloy. The copper is also found in crystals of calc-spar and other minerals, where it must have been deposited with the other constituents of the crystal, and that crystal formed from solution. Other opposing facts might be cited; but it will be sufficient to say that not one sound argument can be advanced in favor of this theory.

2. *Aqueous deposition from above.* This theory, first advanced by Werner, but since generally abandoned, supposes the contents of mineral veins to have been deposited from a solution which flowed into the fissures from above; but in that case the vein-matter should be horizontally stratified, limited in extent downward, and spread over the surface adjacent to the fissure; whereas no one has yet reached the limits in depth of the ore in a true fissure-vein, and the characteristic banded structure can only have resulted from successive depositions of a long-continued flow of a hot solution. This theory has been recently advocated in this city, by Prof. Stewart of Nevada; but it is not only not sustained, but is really disproved by all the facts observed by the writer in some years devoted to the study of our western ore-deposits.

3. *Lateral secretion.* According to this theory, the material filling all mineral veins has leached into the cavity from the wall-rocks. While this is true of gash-veins, it can have played but a very subordinate part in the deposition of ore in fissure-veins. This is proved by the facts that different sets of fissures which cut the same formation frequently contain very different ores; and where the rocks of totally different character are, by faulting, brought to form opposite walls of a fissure, the ore may be symmetrically deposited in corresponding layers. It may also be said that the same fissure frequently traverses several formations, and yet its character may be essentially the same throughout.

4. *Sublimation.* The facility with which certain metals are volatilized, and the fact that various minerals have been deposited from vapor, have formed the

basis of this theory; yet it is difficult to see how any one can ascribe more than a local and insignificant effect to this cause. It is true that the action of water, as steam, is much the same as when fluid and highly heated, in the solution and transport of minerals; and the deposit of mercury; sulphide of iron, and even gold, from the mingled water and steam of the California geysers proves this. So we may concede that steam has been an agent in the chemical solution and precipitation of ores; but this is a very different thing from the sublimation of the metals represented by these ores, and all knowledge and analogy indicate that the silica which forms so large a part of vein-stones, and is so often seen in combs of interlocking crystals, has been deposited from an aqueous solution. But argument is really wasted in a discussion of the filling of fissure-veins, since we have examples that seem to settle the question in favor of chemical precipitation from ascending hot water and steam. In the Steamboat Springs of Western Nevada, for example, we in fact catch mineral veins in the process of formation. These springs issue from extensive fissures which have been or are filling with silicious vein-stone that carries, according to M. Laur, oxide of iron, oxide of manganese, sulphide of iron, sulphide of copper, and metallic gold, and exhibits the banded structure so frequently observed in mineral veins.*

In regard to the precise chemical reactions which take place in the deposition of ores in veins, there is much yet to be learned, and this constitutes an interesting subject for original investigation, which I earnestly commend to those who are so situated that they can pursue it.

It may be noticed, however, that the thermal springs which are now forming deposits like those in fissure-veins, contain alkaline carbonates and sulphides, and we have every reason to believe that highly carbonate alkaline waters containing sulphureted hydrogen under varying conditions of temperature and pressure are capable of taking into solution and depositing all the metals and minerals with which we meet in mineral veins.

To these necessarily brief notes on the filling of mineral veins should be added some interesting examples of the mechanical filling of fissures which have been recently brought to light in western mining. These are furnished by the remarkable deposits of gold and silver ore in the Bassick and Bull Domingo, near Rosita, Colorado, and the carbonate mine at Frisco, Utah. All these are apparently true fissure-veins, filled to as great a depth as they have yet been penetrated, by well-rounded pebbles and boulders which have fallen or been washed in from above. The porous mass thus formed has been subsequently saturated with a hot ascending mineral solution, which has cemented the pebbles and boulders together into a conglomerate ore. In the Bassick, this ore consists of rich telluride of silver and gold, free gold, and the argentiferous sulphides of lead, zinc, copper and iron. In the Bull-Domingo and Carbonate mines, the cementing matter is argentiferous galena. That the pebbles and boulders have come from above is distinctly shown by the variety in their composition and the organic matters associated with them. In the Bull-Domingo and the Bassick, the pebbles consist

*_Annales des Mines,_ Sixth Series, vol. iii, p. 421.

of various kinds of igneous rock, mingled with which in the latter are masses of silicified wood and charcoal; while in the Carbonate mine, the pebbles are mainly trachyte; but with these are others of limestone and quartzite.

Fossils and other foreign bodies have before this been found in mineral veins, and Von Cotta mentions the occurrence of quartz pebbles extending to the depth of 155 fathoms in the Grüner Lode at Schemnitz, Saxony; but no conglomerate veins like those mentioned above are known to exist elsewhere, and they constitute another of the many new forms of ore deposit which the exploration of the rich and varied mineral resources of the United States has brought to light. To enumerate and classify these, has been the chief object of this article.

In regard to the ultimate source of the metallic matters which give value to our ore deposits, but little can be said with certainty. The oldest rocks of which we have any knowledge, the Laurentian, contain gold and copper, which are indigenous, hence as old as the rocks that contain them, and have been simply concentrated and made conspicuous in the process of their metamorphism. These rocks are all sediments and the ruins of pre-existing continents. By their erosion, they have in turn furnished gold, copper, iron, etc., to later sediments by mechanical dispersion and chemical solution. We now find gold everywhere in the Drift from the Canadian Highlands, and we have every reason to believe that all the sedimentary strata more recent than the Laurentian have acquired a slight impregnation of several metals from them in addition to what they have obtained from other sources, and we may conclude that the distribution of many of the metals is almost universal. Sea-water has been proved to contain gold, silver, copper, lead, zinc, cobalt, nickel, iron, manganese and arsenic; and there is little doubt that all the other metals would be found there if the search were sufficiently thorough. Hence, sedimentary rocks of every age must have received from the ocean in which they were deposited some portion of all the metals, and for the formation of metalliferous deposits some method of concentrating these would alone be required. A pretty theory to explain such concentration through the agency of marine plants and animals has been suggested by some German mineralogists, and amplified by Professors Pumpelly and T. S. Hunt. Plants have been credited with the most active agency in this concentration; but evidence is still wanting that either plants or animals have played any important part in the formation of our mineral deposits. The remains of sea-weeds are found in the greatest abundance in a number of our Palæozoic rocks, and it is almost certain that the carbonaceous ingredient in our great beds of bituminous shale has been derived from this source; yet we find there no unusual concentration of metallic matter, and none of the precious metals has ever been detected in them.

The metallic solutions which have formed our ore-deposits have been ascribed to two sources. One theory supposes that they have drained highly metalliferous zones deep in the interior of the earth; the other, that they have leached diffused metals from rocks of different kinds comparatively near the surface. The latter view is the one that commends itself to the judgment of the writer. However probable such a thing might seem, no evidence of the existence of distinct metallic or metalliferous zones in the interior of the earth has been gathered. On the contrary, volcanic emissions, which may be supposed to draw from a lower level than water could reach, are not specially rich in metallic matters, and the thermal waters which have by their deposit filled our mineral veins must have derived their metallic salts from a zone not many thousand feet from the surface. The mineral springs, which are now doing a similar work, are but part of a round of circulation of surface-water, which, falling from the clouds, penetrates the earth to a point where the temperature is such as to drive it back in steam. This, with fluid water under pressure and highly heated, possessing great solvent power, may be forced through vast beds of rock, and these be effectually leached by the process. Should such rocks contain the minutest imaginary quantity of the metals, these must inevitably be taken into solution, and thus flow toward or to the surface, to be deposited when, by diminished temperature and pressure, the solvent power of the menstruum is diminished. It is evident from these facts that we can not trace the history of the metals back beyond the Laurentian age. And since we find them diffused in greater or less quantity through the sedimentary rocks of all ages, and also find processes in action which are removing and re-depositing them in the form of the ore-deposits we mine, it is not necessary to look farther than this for a sufficient theory of their formation.

GEOLOGICAL NOTES ON THE REGION OF SILVER CLIFF, COL.

BY SAMUEL J. WALLACE.

The rough country for twenty miles east of Silver Cliff has been dry land through nearly all the known geologic ages. It is the southern part of an old land which reaches north through the state, and against which the great ocean beat to east, west, and south. This may be termed the Madre land, from the Sierra Madre mountain system, along which it lies, and as being the mother-land of this region.

It was a mountain region, of stratified metamorphic granites, or granitoid rocks. These are traversed by numerous barren leads, and some which bear valuable minerals, iron, lead, gold and silver.

The great Sangre de Cristo range, ten miles westward, is capped by a thousand feet of conglomerate of granitoid boulders, which were washed down from these older mountains, when that was the bed of the sea, since upheaved into the great range of the continent. The core and west side of that range, here, are eruptive granites, and also bear leads with gold, silver, copper and iron. The range bears other sedimentary strata, including limestones, on its flanks north and south, on each side, probably of the same age as those extending south far into New Mexico, and north beyond Leadville, and attributed variously to the Silurian, Devonian, or Subcarboniferous ages. These probably originally covered the whole range. Fossils have been brought from Hayden's Pass, north, but I do not know of what age they were.

About Silver Cliff and Rosita are extensive Trachyte, or light colored lava rocks, bearing mineral. These extend for ten miles nearly east and west; and evidently consist of various outpours differing in their appearance and minerals. Their geology and relations are an interesting field of study.

Perhaps the latest is that on which Silver Cliff is built, which bears a peculiar manganese ore carrying free milling chloride of silver, of the Racine Boy type: this appears over an area of two miles east to west, and a mile and-a-half north to south. It has a black and glossy pitchstone core exposed at various places under it.

North-west of this is another body, rather larger, and to the south-east about Rosita another still larger, which are probably older, different in appearance and with different minerals, iron, lead, zinc, copper, sulphurets, and manganese, with silver diffused through the rocks, and in more or less defined leads. All these carry silver in small quantities, making a wonderful field for future mining, from the immense quantity of the rock and its accessibility. After the melted trachyte was outpoured and by cooling left fissures and deep cavities, no doubt water penetrating the deep recesses of the earth was heated and caused to take up minerals in solution and bring them to the surface, where on cooling they were deposited in various forms in the passages and through the broken and porous trachyte.

The Bassick and Bull-Domingo mines are of this type distinctly, while no doubt lesser and more diffused outruns have produced the minerals throughout the trachyte beds. This trachyte is very old, as shown by hundreds of feet of denudation and ravines cut in it, especially toward Rosita. There is a sedimentary formation, which I have named the Eositon, five miles north-east of Silver Cliff, formed from washings of these old trachyte beds and the granite east. This extends for miles in a line from Dora to Bassick's, in the bed of an old stream, half mile wide. Modern streams have cut down showing nearly a hundred feet in thickness. The strata are mostly soft, some fine grained and some coarse with gravel; often of soft talc-like nature. At one place, west of Cañon road it is capped with a local deposit of limestone, containing granite boulders, valuable for lime.

Half mile west of Apperson's mill the upper strata contain quantities of fossil wood, of many familiar kinds, apparently showing the grain finely. No animal remains have yet been found in it, but it may contain wonders of the time when the monsters roamed this land, whose bones were found by Profs. Marsh, Cope and Mudge, twenty-five miles north, at Prospect Park. There is a stratified sand formation overlying the trachyte north and west, which shows the presence of a body of water at a late age nearly as high as the city, at least. Animal remains, with huge teeth, have been found in this, in the shaft of the St. John claim two-and-a-half miles north-west. There is a deposit of coarse and fine worn gravel for twenty-five miles south and ten miles wide sloping into Grape creek valley, which may be known as the Wet Mountain Gravels.

There are indications of Glacial action extensively in this region, and no doubt these gravels owe much to it. Debris of the Racine Boy type of ores is scattered over the hills for miles north-east.

FOSSIL REMAINS IN SOUTHWEST MISSOURI.

J. L. LEWIS, BOLIVAR, MO.

Southwest Missouri is rich in minerals, abounds in wonderful caves and springs, and her fossils are worthy of scientific notice. The Missouri School of Mines at Rolla is arousing a new interest in our scientific circles, and is doing much to develop our natural resources.

A few years ago Mr. G. C. Broadhead read a paper before the St. Louis Academy of Science, in which he refers to the late discovery of the remains of a horse at Papinville, Bates county, Mo. Mr. O. P. Ohlinger, in digging a well, cut through a bed of thirty feet and ten inches of yellowish clay. Here he found a four-inch stratum of bluish clay and gravel, beneath which was a bed of sand in which the tooth was found. Under this sand bed was a gravel bed five feet deep filled with rounded pebbles, generally hornstone, many of which adhered firmly together. Some of the pebbles taken from this bed were of iron ore, coal and micaceous sandstone. Some remains of fluviatile shells were also found in this gravel bed nearly thirty-two feet below the surface. I have thus described this bed for the observation of others in this district.

The tooth was sent to Prof. Joseph Leidy, of Philadelphia, who, after a most critical examination pronounced it to be the last upper molar of a horse, and he thought of some extinct species. From a similar gravel bed on the bank of the river Marais des Cygnes the fragment of a tusk was found closely resembling that of a mammoth. The full length of this tusk was about seven feet and four inches.

Ten miles from Papinville on the bank of the river Marais des Cygnes there appears to be the same formation as the one above described. Mr. Broadhead considers them to be altered drift, but older than the bluff or Loess. As these gravel beds are abundant on the Osage river and its tributaries, it would be well for those living in this vicinity to be on the lookout for fossil remains, and carefully preserve all such for scientific investigation.

A FOSSIL FOREST.

An interesting discovery has been made at Edgelane Quarry, Oldham, England. The quarrymen, in the course of their excavations, have come upon what has been described as a fossil forest. The trees number about twelve, and some of them are two feet in diameter. They are in good preservation. The roots can be seen interlacing the rock, and the fronds of the ferns are to be found imprinted on every piece of stone. The trees belong to the middle coal measure period, although it has been regarded as somewhat remarkable that no coal has been discovered near them. The coal is found 250 yards beneath.

METEOROLOGY.

TORNADOES.

ISAAC P. NOYES, WASHINGTON, D. C.

By the study of details we learn principles, and only by a proper study of details can we comprehend principles. Principles, however, once grasped and understood, minute details, though still of as much importance in themselves, become a secondary matter to him who has mastered the principles that form the sum total of those details. We have the alphabet, then words, clauses, sentences, etc. The child learns the alphabet, then to form words, and finally advances to sentences and from sentences to composition in general. He who has made himself master of composition, although he heeds the correct juxtaposition of the minor details of letters and words, in one sense ignores them, or better perhaps, let them take care of themselves.

When we advance to science he who thoroughly understands the principles of his department can the better comprehend and explain all its little variations and is not all the while at a loss to explain trifling details or troubled with them as one who has not yet mastered these details.

How difficult it is to understand the situation of objects when viewed from a wrong point, and how easy to comprehend them when the right point of view is obtained. How difficult to understand the interpretations of nature through some wrong theory or false hypothesis, but how plain they become when viewed with the full knowledge of the natural laws that govern them. As for example, how difficult centuries ago to understand and to be able satisfactorily to explain the physical condition of the planets of the universe before the Copernican theory became an established fact, or to explain the properties and full purpose of the blood before the circulation of the blood was established as a fact; surely it has always been a fact, but like many other scientific facts it was for ages unknown to man. Only within the past few years, as has heretofore been stated, have we had sufficient data in the department of the weather whereby we may satisfactorily explain its ever varied changes. The daily weather map has become the instrument whereby we may understand these changes and readily comprehend the principles that govern all our weather, from the warm, quiet, sunny days that predominate in mid-summer to the cold tempestuous weather of winter and spring.

Before we had these data we were greatly in the dark on this subject as a whole. Certainly we understood certain minor details, but we were at the foot of the mountain. Through the weather map we ascend to the very highest peak and with a bird's eye view survey the whole broad landscape. We are lifted above the earth and its commotions of whirlwind and storm, and quietly survey the scene and note its peculiarities with the combined indifference and intense interest of a commanding general surveying a battle or a surgeon performing some difficult operation. Let the elements be ever so quiet or rave so terribly, the weather map lifts us above them and we quietly note the effect and trace up the cause. And the cause of the terrible commotions that so frequently visit us are as readily traced and explained as the most balmy days of "Indian Summer."

One cause produces all the effects and all the effects proceed from one and the same cause, notwithstanding their variety, and whether wet or dry, and the various names given to them. In the past, prior to 1870, it is not surprising that from the minor and disconnected details we should have had queer notions of the weather, and that such names as typhoon, tornado, cyclone, hurricane and simoon should have been coined to represent the wind commotions of the elements in different parts of the earth, and that people should think that there must be as much difference in the things known by these various names as in the spelling and sound of the names themselves.

According to Webster, and others will not essentially differ from this authority, a

Typhoon is "a violent whirlwind that rushes upward from the earth, whirling clouds of dust; probably so called because it was held to be the work of Typhon or Typhos, a giant struck with lightning by Jupiter and buried under Mt. Ætna."

1. A violent tornado or hurricane occurring in the Chinese seas.

2. Sometimes the simoon.

Tornado—"A violent gust of wind, or a tempest distinguished by a whirling, progressive motion, usually accompanied with thunder, lightning and torrents of rain, and commonly of short duration and small breadth; a hurricane."

Cyclone—"A rotatory storm or whirlwind of extended circuit."

Hurricane—"A violent storm characterized by the extreme fury of the wind and its sudden changes; in the East and West Indies often accompanied by thunder and lightning."

Simoon—"A hot, dry wind, that blows occasionally in Arabia, Syria, and the neighboring countries, generated by the extreme heat of the parched deserts or sandy plains. Its approach is indicated by a redness in the air."

Here we have the five principal varieties of storms. At the first glance at the definitions, together with the past ideas in regard to them, it may seem absurd to some to say that they are all one and the same thing, yet nevertheless on general principles one and the same thing they are—effects from one cause and only varying in minor details as affected by local surroundings. All are caused by the rush of air toward the center of low barometer, or by the ever contending forces, heat and cold. The sun shining on some certain spot and at that point creating an intense heat, and this spot or area of heat from the motion of the earth on its axis ever moving toward the east. The intense heat following the law of physics causes the heated and rarified air to ascend and the cooler air from around and about to rush in to fill the vacuum, or better, to prevent a vacuum, for we can never have a vacuum in open nature, as in order to secure that we must have some artificial barrier whereby the air may be prevented from entering the would-be vacuum. The vulgar phrase "just before she does she doesn't," well represents nature in her struggle to create a vacuum. With her, to attain the object that she is ever striving for is an impossibility, and through this impossibility she accomplishes other and greater physical phenomena that keep her ever fresh and impart renewed vigor to her numerous and varied subjects.

The "Typhoon" is the center of the area of low-barometer, or the center of the storm, for it is only at this place that the direction of the wind may be upward from the earth, whirling clouds of dust, the center being the point where the "whirling," if any, takes place as well as the "upward-motion." For at the center is where the winds from all points of the compass on all sides of the storm must meet. I was once in the center of an area of low-barometer in the Gulf of Mexico. The wind was from every quarter and had this whirling motion here spoken of—the upper part of the main-mast of the ship was instantly, in the twinkling of an eye—twisted from its place, where it had been so firmly held by the strong shrouds.

Could we have an ample number of stations in a country where these "Typhoons" are said to occur, we would not only see this effect at its very center, but at a great distance, from all sides, see a rush of air toward the spot where this commotion takes place. The "Typhoon" is more apt to represent the peculiar and intense features of an area of low-barometer in hot or equatorial countries. Still the cause and principles that govern it are not different from the "Tornado" which is the name universally given to severe storms that are liable to occur everywhere, and in the United States occur most frequently in our western territory, although not confined there, as such storms occasionally visit New York and New England. To fully understand the Tornado, one must bear in mind the fact that wind under the pressure of a hundred miles an hour or more, will become quite solidified and will bear along with it objects of great specific gravity. In this respect it much resembles water in great and forcible commotion, as in a storm or freshet. We well know that stone is not buoyant in water when the water is in its normal condition, yet when great storms occur along our Atlantic coasts large stones of three and four tons weight are borne from their places in sea-walls and transported quite a distance. When that dam gave away in Connecticut, some few years ago, stones of immense weight were transported upon the condensed floods for a number of miles.

When a Tornado takes place, the air rushing along a narrow way and being condensed by its great speed becomes, as it were, a thing of life and may even, and does frequently represent an immense serpent going over the ground—dirt, stones and loose materials generally, that lie along its path being swept along with the mighty current. But we are told, that the Tornado has a whirling processive and even bounding motion. This is not at all strange. Unimpeded air, or what may be practically termed such for the time, becomes solidified in proportion to its speed—the greater the speed the more solidity. Then the greater the solidity the more it becomes a thing of life and acts like a living thing. If then in its course it meets with any stationary object it is more or less twisted and turned by that contact, which will readily account for those gyratory motions that belong to this degree of storm and are so often characteristic of it.

How account for the water that so often forms a part of it? may be asked by some. The response to this is, that being wet or dry is merely accidental. But I will pass on to the Cyclone, and take up this point again further on when I come to speak of the late Tornado (of April 18th) in Missouri.

The Cyclone as defined by Webster as being "a rotatory storm or whirlwind of extended circuit" is nothing more nor less than the center of the area of low-barometer. The size of the circle makes no particular difference—the lower the barometric pressure the more severe the storm will be, and as the winds meet at a common and moving center, from equatorial and polar regions or directions, a rotary or circular motion will be imparted to the winds at this point, and their twirling or twisting power will be in proportion to the power of *low*.

The Hurricane seems to be recognized as something peculiar to hot countries. It occurs from the same cause—concentrated heat—and the greater the heat the more powerful the generated force. That it should be accompanied with thunder and lightning is not at all remarkable; indeed it would be more remarkable if it were not thus accompanied.

Wherever there is heat and moisture there will be lightning and thunder. I place lightning first for this is the order in which it should come, the reverse order is the universal practice in using these words simply for euphony, but if we speak of them in the order in which they take place, the *lightning* must take the precedence over the *thunder*. Wherever there is sufficient heat and moisture to form clouds, lightning will be sure to follow, for it is nothing more nor less than a subtile form of heat. This will readily account for the fact that lightning is more the product of warm countries than of temperate ones, and that we in temperate climates have it, with some exceptions only in the warmer months of the year and when it occurs in the winter it is only when we have a remarkably warm spell of weather for the season. So it is not surprising that the Hurricanes of the East and West Indies should be accompanied with thunder and lightning, but rather it would be more surprising if such were not the case.

The Simoon is simply what may be termed a *dry-storm*. It occurs in dry countries where there is little water to generate clouds, and by the way, rain is purely accidental. On all satellite bodies, such as our moon, all the storms that occur there must be after the order of Simoons. If large bodies of water, in the form of lakes and streams, together with extensive woods, could be interspersed throughout Arabia and Sahara there would be no more Simoons there, but they would have just such storms as occur in countries that are well watered.

It is said that the approach of the Simoon is indicated by a redness in the air.

It is very natural that such should be the fact, for in such countries there is always an abundance of loose sand to be taken up by the wind. A friend tells me that he has seen these clouds of fine sand three hundred miles at sea, off the coast of Africa and that the steamer which he was in, was fully a day in passing through this immense mass of fine dust that had been forced by the winds out to sea.

Always when such storms as the late one in Missouri occur, far more comment is made over the mere auxiliary and accidental things than over the germane cause itself. "This storm took up trees by the roots—another demolished houses, fences, killed animals and people—another filled the air with debris—men and horses were taken up in the air—it rained frogs and toads, ashes, dirt, stones etc., etc.—The tornado moved like a huge serpent—a blackened mass—moved in a very narrow path, destroyed this house and just grazed or bounded over that one. The tornado of such a date moved along the earth, carrying everything with it. One of another date took things heavenward and terrible thunder and lightning followed in its course."

We see the same diversity in storms at sea or in great freshets, and yet storms and freshets are not much unlike each other. The same cause that produced them five thousand years ago produces them now, and will continue to produce them so long as our physical condition shall be under the laws which governed the earth at creation and that govern it now.—Though the principles are the same and universal, the details may and will vary with the localities and surroundings. And so with storms in general, whether on sea or land, and whatever lies in the path of the storm will be demolished, unless it be strong enough to resist it.

Wind moving at the rate of a hundred miles an hour will have an immense force and will not permit things, whether they be trees, toads or stones, to lie around loose. If in the way, they will be taken up on the wings of the wind and be borne along until the force of the wind so abates as to be unable longer to carry them, and if perchance it be near the center of the area of low-barometer, they may be carried upward with the ascending waves of the meeting of the currents.

In this country hardly a summer passes, but that we have from one to three or four severe storms, here generally called "Tornadoes." The term or name matters little.

The papers on the 19th of April, 1880, reported a severe storm of this kind the day previous centering mostly in the south-western part of Missouri, but quite extensive throughout the state of Missouri and parts of Kansas. One of the reports of the storm states, that everywhere along the track of the tornado was evidence of a wave of water flowing in the rear of the clouds, and that these waves or currents flowed in greatest volume up-hill, as though there was something very surprising in this fact. Water will naturally run down hill, but if there be sufficient force behind it, it may be forced up to the top of the highest elevation that the earth can produce. When a hill lies in the path of a tremendous wind-storm, it is similar to a rock or fixed object in a stream where there is an immense and rapid current. The water will play about the obstacle if it is unable to carry it along with its force. And so with a hill in a terrific storm of wind and rain. Clouds as well as other things will be swept along with the current and where there are clouds there will be moisture, and the more clouds the more moisture, for clouds are nothing more nor less than suspended moisture, and the denser they become by the powerful squeezing process of the winds, the more apt are they to deposit that moisture and that moisture itself to be carried along as a river in the air.

Another party in discussing this tornado of the 18th of April, repeats the old idea about the cause being the meeting of two waves of air at different temperatures. Notwithstanding the firm belief in this idea, I pronounce it as ridiculous as the absurd notion that the moon affects and causes changes in the weather of our globe, and assert that a more false scientific idea never existed.—And more, I challenge proof in support of either this idea or that the moon has the least possible effect upon our weather system. What gave rise to this idea was evidently the condition of the air at the center of the area of low-barometer. Here such currents must necessarily meet, as cold and warm water might meet in a valley where one stream came from some boiling spring and the other from the melting of ice and snow on the mountain top, but the meeting of these warm and cold currents of air or water would not be the cause of any destruction that they might cause on their passage thither. The cause of the destruction would rather be owing to the rapidity with which they rushed to meet each other in this common center, on the steepness of the hill whereby the force of gravity is accelerated, or the rapid displacement of air by the power of heat at the center of the area of low-barometer.

Then there are people who somehow or other believe that "electricity" is and must some way be the cause of these severe storms, and indeed they go so far as to hold that some are *electrical* and that others are not, but are due to some other cause—but *what*, they do not know. Now the presence of electricity in these storms is purely accidental. The hotter it is the more heat will be taken up with the water that forms the clouds, so the more heat taken thus up into the air, the more electricity will there be in the air to generate the flash and light we call *lightning* and the noise we call *thunder;* which are, as I will repeat, merely auxiliary to the storm and not even essential to it, much less being the cause of it.

In all the comments in the papers thus far I have not seen the slightest allusion to the real and simple cause of this storm of the 18th of April, and the only cause of all storms of whatever nature and local peculiarities and wherever they may occur, whether at the equator or at the poles, or in Asia, Africa, Europe or America.

According to the daily weather map, published by the U. S. Signal office at Washington, at half-past seven on the morning of the 18th of April, 1880, the area of low barometer centered at about Omaha, Nebraska, nearly due north of the place where the storm of the afternoon of the 18th is noted as first starting.

Twenty-four hours later the center of the storm was at Lake Michigan, near Milwaukee, Wisconsin. According to laws heretofore referred to in these articles, the area of low barometer starts in the United States in the West, at least there is where we at present first get track of it in its passage across our continent, and as it travels east trends more or less to the north. This area of low barometer of 18th of April, 1880, traveled in a line very nearly *east-north-east.* The first starting of the storm on the afternoon of the 18th of April, is reported to have been near Fort Smith, on the Arkansas river, in the western part of Arkansas, and that it moved in a northeasterly direction. The next place of importance where it struck is reported to have been Marshfield, Missouri, while the storm, though with less force, also raged in and about Kansas City, Missouri.

Now, if one will study the map, he or she will see that the course of the storm was from the places and localities injured by the storm toward the path of the area of low barometer. Here is the simple and universal cause of all storms of this nature—a cause and effect that any one of ordinary intelligence may readily understand if he will only heed the signs. If the intelligent will not heed the signs, why, then they will be as much in the dark as the ignorant, and if anything more so. And so it is not surprising that we see published in respectable papers such ideas as that there was a similarity between the storm in Kansas and one in the Island of Sicily, in the Mediterranean, two days afterward, and that therefore both were of meteoric origin. "The Kansas dust was composed of brown and black impalpable matter, and so abundant that on the next day traces of the deposits could be seen on the surface of the ground, and on a north porch sufficient to receive the imprints of a cat's feet" * * * The near coincidence of dates between the phenomenon in Sicily and here (Kansas), with an apparent similarity in the physical properties of the dust, might suggest a common origin."

In the first place, I would like for the author of the above to publish to the world what a "meteoric" storm is; how it is to be distinguished from other storms; what are its peculiarities; what its general nature, and whether it is dependent upon the influence of the properties of high or low barometer, or quite independent of them. In the next place, if he knew any thing about the rapidity of storm centres, or the speed at which the areas of low barometer, which causes the storm, travels, he would have seen that it could not possibly pass over such a distance in two days, as from Kansas to Sicily, and more than this, that it is very doubtful about an area of low barometer which passes over Kansas traveling in such a direction as to pass over Sicily, or take any such like of latitude as Sicily in its course.

The area of low barometer travels with greater or less speed, probably anywhere from three hundred and fifty miles to even double this distance a day. The force or rapidity of the wind toward the center of the area of low barometer has nothing directly to do with the rapidity of the area of low barometer, but with its intensity. Relatively to the storm the area of *low* is stationary. Then as to the direction of the winds in such storms this is purely accidental, though in America these winds are mostly toward the east. I say *toward the east* rather than *from the west*, for the reason that winds are pulled and not pushed—the force that creates them is always in advance and not behind. These storms, though generally toward the east are not always so; it depends on the location of the area of *low*. When the area of low barometer is on the land, the storm almost always follows this course, for it is natural that the greater force of the wind must be in the track of *low* as it advances toward the east from the west. For in this case we have not only the force of the wind in proportion to the intensity of this area of low barometer, but we undoubtedly have added to this the progressive force of *low* as it advances toward the east. So our tornadoes are mostly in the track of a storm toward the east—most, but not always, for some. times, more especially when the area of low barometer is on a high line of latitude, the storm takes place or begins with a southeast wind. This at first may seem contradictory to previous statements, and so also may the statement that, relatively to the storm the area of *low* is stationary, but with a little study of the weather maps in connection with storms it will be seen that the wind is ever changing as the area of *low* is passing over the country. In the east first the wind will be toward the west and to the south or north of due west as the area of the advancing *low* is on a low or high line of latitude—then, after the passing of *low* more or less reversed, or toward the east. To understand this better, let any one take a sheet of paper and mark its four sides—North, East, South and West. Over the paper sprinkle some iron filings. Then, near enough to attract the iron, slowly draw a magnet from the west toward the east. It will be seen that the magnet will attract the particles of iron as it advances, and from all quarters, and that as it advances it will take up particles of iron with it, and that relatively to the iron the magnet is for the time being stationary, though the particles of iron will follow the movements of the magnet. This, so far as iron will permit, is a fair illustration of the attraction or pulling power of *low* over air, though iron being a far more inert substance than air, is not so readily or extensively affected by the magnet as the air is by the attractive force of *low*.

Then, as to the direction of the wind in a tornado, instead of being toward the northeast, or toward the northwest, it may in some localities be from the northwest, as in Washington, July 4, 1874, and yet in the track of *low*. A south west wind had been blowing all day—or in other words *toward* the northeast. Suddenly the wind changed to the northwest and blew a terrific storm that uprooted trees and unroofed houses in this locality.

In the early part of November, 1877, we had a similar storm on Long Island Sound, when the steamer Massachusetts, being caught by it on a lee shore, came near being a total wreck. In these instances the cause was the same as created the late tornado in Kansas and Missouri, only the area of low barometer was in another locality, and, therefore, the wind that caused it must be from a different quarter. It was in the track of the area of low barometer.

After all this comment on what a tornado is, the question arises, is there no preventive? There would seem not, at least at this present state and power of understanding. We may, however, ameliorate the force and concentration of the storm by the abundant planting of trees, which will have a tendency to break the force of the storm.

In conclusion, I would remark, or perhaps better, repeat, that the area of low barometer is the center and generating influence of the storm—the center toward which the winds from all quarters will blow, and the force of these winds will be in proportion to the intensity or lowness of pressure at this center of *low*. This area of low barometer is ever on the move toward the east or toward the advancing sun, and its motion, at least so far as we know on land, is never reversed, although there is some probability of its changing its course on the ocean after passing off the land, as discussed in former papers. But its course on the sea, at least after passing off our coasts, is at present unknown to us. We only know that the wind is always toward *low*, and that in passing off the coast, more frequently than otherwise, the wind after just having been from the southwest, comes out from the northwest.

In order to fully explain this, we must have some stations out on the ocean; either stationary, as a light-ship, or movable, as a steam vessel might be. When this can be accomplished, we can study the direction of *low* after passing off the coast; until then we can not be certain as to its location beyond what inference we may draw as to the direction of the wind. We do know that the wind is always toward *low*, and furthermore, that tornadoes, hurricanes, or by whatever name we may call a storm, it always will be in the wake or track toward this center or area of low barometer, wherever it may be, and that a tornado is always in order after the passing of *low*. Fortunately for us, the conditions of nature are not always favorable to it; if they were, we should have them at least once a week, and sometimes oftener.

What becomes us now is to carefully study out the course of *low* every time it passes over the country, note the conditions when a tornado occurs and when not. By careful noting of data, by and by we may be able at least to say when one will occur and when not, and as we advance in knowledge, we may, by the judicious planting of trees, or by other means not now plain to us, in a measure prevent their occurrence, or at least diminish their severity or intensity.

AURORA BOREALIS.

PROF. E. R. PAIGE.

The cause of this singular phenomena has been a prolific subject of both scientific and unscientific discussion for many years.

To the mind educated in cause and effect the canopy of night, lighted up by the dancing specter, presents a most alluring sight: while the unenlightened are filled with dark forebodings of a visitation of God's wrath, the scientist sees only the grand workings of the immediate laws of nature.

The heavens illuminated with red light is to the superstitious a sure harbinger of impending wars: while the careful observer looks with delight upon the scene, and is impressed only with the sublimity of nature, poor unreasoning man is tortured with fears of coming evil.

In the slow development of scientific knowledge, many and varied have been the theories put forth as to the origin of the Northern Lights, as we in this hemisphere call them. It is the reflection of sunlight by the ice at the pole, says one, while another contends that it is produced by great and internal fires whose chimney occupies the space devoted by Dr. Kane to an open polar sea; but the more patient observers have pronounced it electric light. It is my present purpose to look out through the light of a few known facts in search of the origin of this great wonder. Not that any direct good will follow a successful inquiry in the matter of utilizing the light for street purposes or for private illumination, but if we can find the cause to be natural, and not supernatural, then one more old superstition that has haunted the memory and made life unhappy is gone—one more bugbear of tormenting fear is consigned to the shades of past ignorance. Newton discovered the law that controls the universe, and every child should be taught this law, for without it we can comprehend nothing in nature. How life is produced, how worlds, how suns, and planets formed and held in their orbits, is known only through this law.

"Each atom has an attraction for each other atom in the universe, and the attraction is proportionate to their size, and is lessened as the square of the distance which separates them increases." Late developments in scientific research lead to the conclusion that all the varied original elements in nature, so-called, are resolvable back to one, and that one to energy. Also that light, heat, electricity and sound are only different phases of motion.

Heat is the arrest of motion, and all the warmth we get from the sun is produced by the stoppage of the heat waves sent out by its throbbing power. Chemical heat is created by the clash of little worlds of gas beating together, and no exception is known to the rule, that heat is the arrest of motion.

All the heat and all the energy we get on the earth come from the sun. The rainclouds are lifted from the ocean; the winds sweep over the mountains and across the moors, the blood of life, the sap of vegetation, all propelled by the power of the sun. The visible power expended on our little globe passes all efforts of comprehension, but it is naught compared with the latent hidden energy. The decomposition of one drop of water produces a power equal to the most terrific thunder storm ever witnessed, while the decomposition of one grain of water produces a force equal to the discharge of 800,000 Leyden jars. All this but shadows the vast amount of energy that comes to us from the sun. Our earth is but a speck in space, and not a two thousand-millionth part of the energy thrown off by the sun strikes us, but is expended out in dark, empty space. This involves a vast waste by the sun, and experiment shows that the sun would be exhausted and cooled down in 5,000 years if not replenished from some source. The earth is passing around the sun once a year over a path 555,000,000 miles long, traveling at the rate of 68,000 miles an hour. The speed of our flight is eighty times more rapid than the swiftest flying cannon ball. If the globe should strike a dead wall passing at this great speed, the concussion, we are told, would burn it instantly, creating a heat of which we have no comprehension; and yet the heat produced by such a catastrophe would not be sufficient to last the sun's waste for a period of thirty days.

We are taught, however, that if the earth should let go its place in space and be attracted into the sun, that body, being 325,000 times more than the earth, and, therefore, possessing 325,000 times more power of attraction, its immense pull would draw us in with such a velocity that the kinetic force gathered in the passage would produce an impact in striking that would give off heat sufficient to last the sun's waste for a period of ninety-one years.

In any hour of a clear night that we watch we shall see at least six or eight stars fall. These stars are simply small pieces of iron gathered and formed in space that have fallen into our atmosphere in our flight around the sun; that is, have been attracted into the orbit of the world and picked up. Coming into our atmosphere when it is passing with such velocity creates a friction—a concussion—an arrest of motion, that immediately burns the iron. We see the explosion and call it a falling star. If an unaided eye can see six fall in one hour of the night, then what a vast shower must be constantly attracted by the whole earth. If the little earth with its slight power of attraction brings in such a constant shower of cosmic matter, how much more would be attracted by the sun, possessing 325,000 times more power of attraction than the earth. Such is the case, we are told, and our grand constant shower of cosmic matter is constantly falling into that body, forming a vast corona extending out from the sun 800,000 miles, by the clashing and impinging of particles aad resultant burning. Thus, by virtue of the law of attraction, one constant stream of matter, which is energy, is pouring into the sun to replenish its waste. This matter must be formed in space, and is simply an aggregation of energy, or fire-mist, that pervades the atmosphere.

The cosmic matter that falls on the earth, that is meteoric matter, is about 85 per cent. iron, and is merely an aggregation of iron-dust, which is itself an aggregation of invisible fire-mist. Great clouds of this fine iron-dust gather in the heavens, and are occasionally attracted into our orbit. On striking our atmosphere, flying with such great speed, the concussion, the arrest of motion, instantly burns the iron-dust and produces light colored according to the surrounding conditions that produce the refraction. This theory is not without its objections, and the chief one is perhaps the fact of these lights occurring toward the poles. This objection, I think, can be met, however, in the conditions that produce refractions of light, but our article affords no space to enter upon that field.

The facts I have alluded to as a basis for reasoning are, of course, not my own, and I shall not be deemed immodest, I hope, in saying that they are all well established and may be accepted as true grounds of reasoning.

This being so, it does seem that the wonderful aurora borealis may be fully accounted for in the burning of iron-dust that gathers into great clouds, and floats into our flying atmosphere to be burned by the concussion.—*Inter-Ocean.*

PHYSICS.

THE MANNER OF WORKING THE ELECTRIC TIME BALL.

PROF. C. W. PRITCHETT.

Dr. Case :—In an editorial note in the last number of the Kansas City Review, attention is again called to an electric time ball for the Union Depot, Kansas City.

Since June 3, we have transmitted to the Union Depot, by the Western Union telegraph, a daily time signal, at 4 P. M. The manner of sending it is as follows: At about five minutes before four o'clock we call Union Depot and advise the operator of the nearness of the signal. This is also a monition to all other operators to keep off till the signals are sent and acknowledged; and by special instructions from the Superintendent, they are under obligation to heed this monition. At the proper moment, one of the brake-circuit clocks of the Observatory is instantaneously switched into the line through a relay, and begins to record each of its seconds, on every sounder between Mexico and Kansas City.

The first second marks 3 h., 59 m., Kansas City mean time.

The sixtieth second marks 4 h., Kansas City mean time.

The 120th second marks 4 h., 1 m., Kansas City mean time.

The sixtieth second is specially distinguished from all others by an extra break, interpolated by hand before it and also by a like extra break immediately after it. There are thus three chances for the operator to get the exact second, if any interruption occurs. I am glad to say that, generally, the signals are allowed to pass uninterrupted. Sometimes, however, they are marred by operators either through forgetfulness of instructions, or through ignorance of them. I am reluctant to believe that they are sometimes interrupted through mischief. On several occasions keys have been left open, or the line has been down or grounded, and hence the signals have failed.

A word as to the accuracy of these signals. In sending them the difference of time between the Meridian Pier, of Morrison Observatory, and the Union

Depot, has been assumed to be 7 m. 5s. This difference is probably correct to within one or two seconds. It has been deduced from actual measures, in which the effect of convergency of meridians, and the spheroidal figure of the earth has been duly computed. It is desirable, as early as possible, to determine the exact difference of time, to within a small fraction of a second, by time determinations made on the ground and by exchange of clock signals by telegraph.

The signals themselves are always correct to the nearest half-second of the clock. The error of the standard clock is daily ascertained by standard stars. Fractions of a second cannot be sent out by the clock itself, unless a Hack-clock be used, and set to the fraction of each transmission.

Now, a word as to the proposed time-ball. It might be a public convenience, and at little expense; and by a little adjustment and punctuality it could be made a visible indicator of correct time for thousands. It is entirely practicable to drop it from the Observatory; but in view of liability to interruption it would be safer for the operator at the Union Depot to do so by touching a spring at the first extra-break of the four o'clock signal. A light elastic hollow ball, several feet in diameter, and having the figure 4 conspicuously painted round the the margin of a great circle, could be easily run up a staff by a cord a few minutes before the time, and could be made to descend instantaneously at four o'clock, by the simple touch of a spring. I simply suggest this. We send the signals and leave it to others to make them as useful as possible.

Very truly yours,

C. W. PRITCHETT.

MORRISON OBSERVATORY, July 15, 1880.

NOTE.—The time-ball at New York is dropped by the first break of the Washington clock. To prevent interruption from operators, the operator at New York presses against the armature of his relay, until a few seconds before the signal.

THE ELECTRIC RAILWAY.

Now that the possibility of an electric railway has been fairly put before the public by Dr. Siemens, we may expect to hear more about it before many years.

The commercial advantages of the system must, of course, determine whether the Electric Railway will be extensively used or not. The question is not entirely one of economy of fuel; safety and convenience are elements which greatly affect the commercial profitableness of any undertaking, and these must be taken into consideration in making an estimate.

As yet, the new means of locomotion has only been experimented upon on a comparatively small scale, but the results have been quite sufficient to justify a favorable conclusion being drawn.

The idea of an electric railway is by no means new; little model engines, which ran backward and forward on a pair of rails, or round and round in a circle, were often to be seen in the windows of the shops of scientific instrument makers in the early days of electrical science, and the suggestion to apply the principle on a large scale was such a natural one that it is necessary to go back to a somewhat early date in the records of the Patent Office to find the first patent for an electrical railway. So long as the motive power was dependent upon galvanic batteries but little success could be obtained, but the introduction of dynamo machines altered the question entirely and brought the idea within the range of economical possibility.

For underground railways the system is specially suitable, and those who travel on the Metropolitan railway during the dog days must often devoutly hope that some change in this direction will be made at no distant date. Already it is contemplated to work the traffic through the new St. Gothard tunnel by electricity, and plans and designs for the purpose have been in hand.

Railways worked by electricity will, however, have to compete with a formidable rival in the shape of railways worked by compressed air locomotives. This latter means of producing locomotion appears to have waked up again and is likely to have considerable employment.

For very short distances, where the traffic is heavy and irregular, as for instance, on the small branch lines used so frequently in mining districts, the electrical railway could be used with great advantage, especially if natural sources of power were available.—*Telegraphic Journal.*

GEOGRAPHY.

PERSONAL RECOLLECTIONS OF ORTON AND PERU.

BY DR. I. D. HEATH, WYANDOTT, KANSAS.

(*Concluded.*)

The mosquitoes are excessively numerous and annoying. Sleep is absolutely impossible without netting. Each Indian and traveler carries with him a toldeta or small cotton tent, three feet high, three feet wide and seven feet long which he sets up by means of small sticks. The Indians brought to us gums, resins, dye woods, medicines, barks and herbs and textile plants.

Trinidad, a place of 5,000 in a beautiful grove of tamarind trees, is the capital of the Department of the Beni, and a place of considerable trade and business. It is on the margin of the immense grassy pampas of South America where graze countless herds of fat cattle. Imports consist of every class of manufactured American and English goods. All goods into Peru and Bolivia by way of the Amazon enter duty free. Exports are hides, coffee, chocolate, beans, tobacco and, from down the Yacuma river, rubber and Peruvian bark. Rice, corn, sweet potatoes, sugar, rum and all tropical fruits are produced in abundance. Fresh beef retailed in the market at 2½ cents per pound. During the month of May, we found the temperature to range from 61 to 86°. The cathedral here is said to be 180 years old. One of the bells had cast in it the date 1729. During our stay in Trinidad the feast of the Holy Trinity was celebrated—the patron saint of the city. Three days and three nights Indians, dressed in magnificent feather robes of brilliant colors, danced in front of the cathedral. Their heads were covered with a cap supporting long feathers of the macaw, feathers three feet long which were arranged to represent the rays of the sun, the object of their former worship. A few made music from drums and from thigh bones of large birds pierced with holes for flutes. Other Indians were armed with knives, tomahawks and war clubs. The Indians kept step to the music, brandishing their weapons and slowly advancing to the open door of the sacred building from whence they would suddenly and quickly retreat to the plaza and then again slowly advance. On the third day hundreds of men and women dressed in long white robes marched in procession from the church bearing the life-size images of the virgin and saints. As soon as the image of the virgin appeared outside, those representing the ancient religious rites fled in fear and dismay.

The birds here are very plenty and extremely beautiful. Fifty were shot and their skins preserved. Little groves of the fan palm are a pretty feature of the pampas. In places are numerous ant-hills four to six feet high. There is little industry; the ruling classes are Spaniards, gentlemen, and must not work. The Indians perform the labor and receive $3 to $4 per month.

Here the Professor bought and paid for two barges of three and four tons each, equipped and provisioned them for three months. The provisions were charque, a kind of dried beef, farina de yuca (our tapioca), rice, sugar, coffee, chocolate, sugar, molasses, yuca and plantains. He hired a crew of eleven Canichana Indians and another crew of nine Machupos. For the protection of all he engaged ten Bolivian soldiers, paying their salaries. He disbursed $1,200.

On the 1st of June we set out and once more voyaged down the Mamore river—our general course due north. We passed by pampa and forest, by cattle and sugar estates, by plantain, orange and chocolate orchards and groves of tamarind trees.

We stopped a day each at San Pedro, Santa Ana and Exaltacion, where the Professor made observations for the determination of altitude, latitude and longitude, as was also his practice at every important point. We hunted the ostrich and tiger, wild turkeys and water birds and made collections of everything interesting to science. Wild turkeys and fish are in great abundance. We were enjoying a delightful climate, floating or paddling down this great river, one and two miles wide and at this season of the year of unknown depth. Everything was new, strange and interesting. There were more than fifty varieties of palms, more than fifty of beautiful cabinet woods. What destiny would steam and modern civilization work out for this country? What new resources might not science discover?

Why may not benevolent societies be organized in every Christian nation of the world for the purpose of transporting the starving millions of Persia, India and China to the fertile plains and Italian skies of the great Madiera plateau of South America? a country that could never be wanting in beef, rice, plantains, corn and fish.

After fourteen days of paddling we reached the rapids of Guajaramerim in Brazil, only eight leagues distant from those unexplored lands, the object of our long and expensive journey. Here the soldiers mutinied, and, with charged muskets leveled at the Professor's breast, deserted us, taking away with them one-half our outfit. Slowly we made our way back up stream to Santa Ana and there changed to ox carts and saddle horses for a journey of 200 miles west through the cattle estates of the pampas. The country is nearly level and its general appearance much like of the prairies of Illinois previous to their settlement. Our route was not distant from the timbered line of the river Yacuma. Other pieces of timber were seen and clusters of the graceful fan palm. It is a beautiful, quiet, pastoral country. Each of the carts were drawn by two pairs of oxen yoked together after the Spanish method by straight sticks fastened with thongs back of the horns. The carts were entirely of wood, well made, without one particle of iron in their construction. Upon the carts were placed boxes of rawhide for the reception of the baggage so that while crossing the many streams that drain the pampas, the Indians, oxen and carts were all swimming at the same time.

At the time of our visit cattle were reckoned scarce and high-priced. A few years previous they existed in such vast numbers that the government at La Paz sold permits for their slaughter at $1 per head of those not branded. Millions of cattle were killed for their hides and tallow. In 1877 a cattle estate, land and all, was valued at eight pesos ($6.40) per head for all those over one year of age. Tiger's are greatly feared and are destructive to young stock. Each estate keeps twelve to fifteen powerful dogs to watch and fight the tiger whose skin will cover as much ground as that of a cow.

In the latter part of July we arrived once more in sight of the mountains at Los Reyes. At this point is he who addressed you two years ago on "Peruvian Antiquities"—Dr. Edwin R. Heath. He arrived in Los Reyes last September by way of the rivers Amazon, Madeira and Mamorè. He is engaged in studies and making collections in the interests of science and getting ready an expedition to work out the unfinished task of Prof. Orton—an undertaking full of difficulty and danger—but for the accomplishment of which he possesses the experience of those who have gone before him, a long and intimate acquaintance with the Spanish character, language and of their country, and an indomitable energy; and if he fails in the task before him it will only be from want of sufficient funds.

But to return to the expedition of 1877. Arrived at the foot of the mountains the next two stages must be made on foot—180 miles. Engaged sixteen Indians for the baggage, each one carrying sixty pounds besides his own food and blankets, and traveling six to eight leagues per day. The Professor bought a saddle mule which on the third day, while being led around a dangerous place, slipped and rolled down out of sight, dead. Out of 170 head of fat cattle that started for Apolobamba over the same road at the same time with ourselves 130 were lost by accidents on the way.

Both ascending and descending this eastern cordillera we saw the Cascarilla and Peruvian bark tree newly stripped. One species with leaf as broad as the hand is found up to 5,000 and 6,000 feet, and another having leaf the size of an apple leaf grows only at greater elevations. The gathering of the bark is a destructive one, and the tree has almost entirely disappeared from lines of travel. We met many Indians loaded with bark. The Indians constantly use coca leaves with which in the act of chewing they mix ashes of a palm nut. They claim that it allays hunger and fatigue. Professor Orton, sick and almost utterly exhausted, drank hot infusions of coca two or three times daily and declared for it marvelous power to restore his strength. The mountain scenery over this route is magnificent, and is called the Switzerland of America. Mountains 6,000, 8,000 and 10,000 feet in height with intervening valleys all densely wooded, and rich with the deep green of the tropical forest. Of one view the following was written on the spot: Not far from Mamacuna we have our first clear unobstructed view in the west of the central cordillera stretching away from north to south as far as the eye can reach. In the foreground and all about are mountains 7,000 to 10,000 feet in height, but high up above for a magnificent background stands this dark barrier with its white crest of snow and ice reaching 18,000 to 20,000 feet up in the sky. No mortal ever saw a grander sight. Professor Orton declared it the most splendid view he had ever seen. We could stand here all day, but the silent Indians were moving on.

Apolobamba, 2500 inhabitants, in valley of same name. Coffee, corn, yuca, potato, plantain, oranges, pineapple and sugar cane. Sixteen days in Apolo. Last of August and first of September. This valley is noted for its coffee. The bushes stand six feet in the row and rows eight feet apart. We saw them in full bloom. There is nothing of the kind prettier—long, slender stems, leaves opposite and drooping, and at the axiles of the leaves long rows of erect clusters of pearly white flowers. Near Pachimoco there were three coffee trees as large as apple trees, said to produce annual crops of seventy-five pounds to each tree.

Throughout Peru and Bolivia there are many commercially educated Germans, who almost invariably speak four languages. At Apolo, we dined with Don Carlos Frank, a German dealer in Peruvian bark, who spoke correct English, Spanish, French and German, to his guests at the table, and Quichua to his servants. He was paying $32 per 100 pounds for poorer qualities, and $80 for best qualities of bark.

Mules again to Pelechuco, 41 leagues. Pelechuco, 10,500 feet elevation, in the Quichua, signifies "Corner of the mist," because from its peculiar position at the head of the valley and just under the snow peaks, the town is much of the time enveloped in cloud and mist. Temperature at mid-day 48° Fahrenheit. Mules and llamas do the freighting. Llamas are driven very slowly, sometimes in great herds. They carry seventy-five to one hundred pounds, and are valued at $4 to $5 each. September 18th, we crossed the summit in the midst of mountains of snow—temperature 24°—and thence by easy roads descended the valley of the Escoma to Lake Titicaca. Along this valley at an elevation of 13,000 to 15,000 feet, saw, millions it might be, of alpacas grazing—prevailing color black. At last, after six months of out-door life, we embarked in the schooner Aurora for the city of Puno. The Professor dropped down on a heap of sail cloth, exclaiming, "I am so glad! so glad! We'll have no more mules, muleteers nor Indians, no more annoyance, trouble or disappointment. I am so tired! so tired!" and quickly fell asleep. Just before daylight of September 25, after a night of unusual storm, he became conscious that he was dying, and there, among strangers, whom, twenty-four hours before, we had never seen, on the highest navigated lake in the world, 13,000 feet above the ocean, far away from wife, children and friends, calmly, quietly, without a struggle or a word of complaint, he died.

But his final resting place is a glorious one, eminently befitting his life and career. It is upon the summit of a rocky island in Lake Titicaca, many thousands of feet nearer the sky than are most sepulchers. There he lies in sight of the scenes of his last explorations; upon one side is discerned the last mile of iron rail and telegraph, and on the other, that mysterious lake and island from whence issued the great Inca monarchy.

As he himself wrote in memoriam of Col. Stanton, a companion in a former expedition, who was buried in Quito: "He was buried without parade, and in solemn silence—just as we believe his unobtrusive spirit would have desired. No splendid hearse nor nodding plumes; no long procession save the unheard tread of angels; no requiem save the unheard harps of seraphs. Snow-white pinnacles standing around him on every side, we left him in this corner of nature's vast cathedral; secluded shrine of grandeur and beauty, not found in Westminster Abbey."

At this time, with Professor Orton, died Mr. Henry Meiggs. Every station, engine and car, was draped in the deepest mourning—engine drivers vying with each other in decorations of respect.

They relate many anecdotes of Don Enrique Meiggs, as railroad men call him. Many years ago a civil engineer of rare ability and training, was at work on railroad surveys in Georgia at a salary of $80 per month, when an agent of Mr. Meiggs offered him $125 per month, gold, and free ticket down and back, to go to Chili and make surveys on the railroad to Santiago. He went. Month after month he received his $125, while the other civil engineers received $333 per month. He was advised to break his contract and demand higher salary, but his high sense of honor would not submit to a violation of his pledged word, and so he toiled on month after month and year after year, to the end of his term—one of the best engineers in Don Enrique's employ. Just before sailing for home he was among invited guests to Mr. Meiggs' residence, and, seated at the table he found under his plate a check for $40,000. Subsequently Mr. Maynadier was chief engineer and superintendent of the Pacasmayo railroad at a salary of $10,000 per year.

Immediately after having taken the contract at $28,000,000, to build the Oroya railroad from Lima over the mountain to the Jauca valley, Mr. Meiggs sought to obtain special freight rates from an English company operating a line from Callao to Lima; this company having obtained the concession from the Peruvian government of exclusive rights for the term of twenty-five years, the new road *must*, necessarily, commence at Lima, and every pound of the immense material *must* come over the English road from the sea port. Mr. Meiggs was referred to the printed schedule figures. On no account would reduced rates be granted. They rather enjoyed their advantage over the successful American contractor. Soon the railroad material began to arrive; it went over the English road and freights were promptly paid. The new road had many miles graded up the valley of the Rimac—several miles of track laid and supply trains running, when suddenly, to the astonishment of all, 1,500 men began to throw up road bed and lay track *down* the Rimac toward the ocean. Of course the English company notified Mr. Meiggs that this enterprise must cease, that it was a direct infringement of their exclusive rghts. Mr. Meiggs said nothing, but his men worked right on, laying a mile of track per day. The Englishmen were amazed and appealed to the government, which formally warned Mr. Meiggs to desist; but still the work went on. Troops were ordered out to suppress this mob of Yankee enterprise, till the matter could receive a judicial investigation, when, at the last moment, Mr. Meiggs quietly informed them that he was building a private road on private land, and that there was no law in Peru that could stop him. Mr. Meiggs had quietly, unknown to the public, bought three haciendas, extending from the Monserrate station, in Lima, to the Guadalupe station in Callao, and in the center of this princely estate, at Villegas station, the tomb of the dead contractor is in plain sight from the passing trains of the Oroya railway.

The mountains are peopled by the Quichua and Aimara Indians, relics of the once powerful monarchy of the Incas. They were skilled in the art of spinning, weaving and dyeing, both woolen and cotten, centuries before the coming of the Spaniards. Even to-day, as they tend their flocks of sheep and alpaca, their hands are busy twirling the distaff and forming balls of yarn, while humming some gentle melody in the ancient Quichua tongue. They wrought in gold, silver and copper. They retain the Quichua language in the family circle—many of them never speaking the Spanish. They publicly profess the Catholic religion, but still have not forgotten their ancient religious rites. They cultivate potatoes, barley, wheat, rear cattle, horses and flocks, and toil in the mines.

In every city there are Italians, Germans, and of course, on the railroads, Americans and English. One hundred thousand Chinese have been introduced into Peru under a contract for eight and six years of labor. There are now nearly 80,000 free Chinamen who speak the Spanish language, have adopted the western dress and, marrying native women, have settled down as permanent citizens of Peru. As slaves, they are worked in sugar cane and rice fields—and free they are keepers of shops and eating houses and toil upon railroads and in mines. Outside the large cities, the only public eating houses are the Chinese fondas, and these are patronized by all classes.

The material resources of Peru and Bolivia, are enormous. The fertilizer, guano, is found on the rocky promontories and islands along the entire Peruvian coast. The government receives $36 per ton. It is the revenue from guano, without one cent of tax from the people, that has enabled Peru, under the direction of Henry Meiggs, to perform those gigantic feats of railway construction. Millions of tons have been exported, and many millions of tons remain.

From the earliest date, Peru and Bolivia have been famed for their mineral wealth. Gold has been found in many provinces. In the districts of Carabaya and Tipuhuani, mines have been worked ever since the Conquest. Silver is most abundant—probably not wanting in any one of 1,500 miles of mountain range. The silver mines of Hualguayoc, Chilete, Cerro de Pasco, of Puno and others were worked before the Conquest, are still worked, but in the most primitive manner, without machinery—the metal bearing rock being carried to the surface in rawhides on the backs of Indians; each vein being abandoned when covered with water. Quicksilver, copper, lead, zinc, are also mined.

Sugar cane comes to maturity in sixteen months, producing eight to ten annual crops without replanting. For the production of sugar on the coast of Peru, there are no seasons—the sugar mill never stops. During 365 days of the year the cane is cut, when the field first harvested, is again ready for the knife. The mills produce many tons of sugar each day—there are two of the capacity of sixty tons each twenty-four hours. The profits on sugar production are nowhere so large as in Peru.

It is claimed that Peruvian cotton commands a higher price in the London markets than the American, and that the climate, soil and system of irrigation produce fine crops of Sea Island cotton.

Near Pacasmayo, in northern Peru, grows a variety of coffee of such delicious aroma that the entire yield was sold at $1 per pound from the haciendas.

If there is any specific for pulmonary consumption, it is the climate of Peru. A carefully kept record of the temperature four times each day for four years at our hospital in Pacasmayo, gave us 86° for the hottest, and 58½° Fahrenheit for the coldest day—a variation of only 28° in four years. In many confined valleys from middle of December till middle of March—the three months of their summer—the mercury rises to a hundred and over, but all enjoy nine months of our May and September. I believe that every consumptive who possesses strength sufficient to travel, can find somewhere, within one hundred miles, between the sea bathing of the coast and elevated mountain valleys, a climate exactly suited to his physical condition, in which, among fruits and flowers, with doors and windows ever open, he will enjoy sound health and long life. While in Cajamarca, fourteen persons were pointed out whose baptismal records dated back 120 years and more.

Sugar, tobacco, cotton, hides, wool, bark, and minerals have been offered in such quantities that the P. S. N. Co., commencing with two small wooden steamers, have had built eighty iron steamships varying in size up to 4000 tons each. The greater portion of the immense freight goes to Europe by the Strait steamers. With a ship canal across the Isthmus of Panama, the United States would be able to send a much larger merchant marine to the west coast of South America.

I have read that at the time of the Conquest, the Incas were ruling over a population of 30,000,000 of people. With the American school book, engineer and telegraph, with an exhaustless supply of mineral wealth, a fertile soil and a perfect climate, with swift running steamers connecting her ports with all the world, to what degree of population and wealth may not the Republic of Peru again attain?

ARCTIC RESEARCH.

FROM THE ANNUAL ADDRESS OF THE EARL OF NORTHBROOK, PRESIDENT OF THE ROYAL GEOGRAPHICAL SOCIETY.

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The examination of any part of the vast unknown region surrounding the North Pole is interesting to geographers, and discovery in this direction seems to have a peculiar fascination for maritime explorers. A year seldom passes without some effort being made to add to our knowledge in the far north. During the last summer two voyages of reconnoissance were undertaken in this direction, one by the Dutch under Captain de Bruyne, and the other by our associates, Sir Henry Gore Booth and Captain A. H. Markham, R. N. The Dutch officers actually sighted Franz-Joseph Land, while our countrymen attained a remarkably high latitude at a very late period of the navigable season. I understand that in the coming season, Mr. Leigh Smith, whose name is already honorably associated with Arctic yachting, will make a voyage of reconnoissance, which, if circumstances prove favorable, may become a voyage of discovery. The American expedition, which sailed from San Francisco last year for Behring Strait, is believed to have wintered in the pack, and tidings of it may soon be expected.

I have quite recently received information that the Government of the United States have decided upon sending out another Arctic Expedition, via Smith Sound, under Captain Howgate. This is a project which has been some time under consideration, but has only now been matured. It is intended to make a temporary station for Arctic observation and discovery in the latitude of 81° 40' on or near the shore of Lady Franklin Bay. The expedition will consist of twenty-five people, who are to go up there in the Gulnare, a steamer of two hundred tons. The proposal is that they should endeavor to push on to the North Pole by slow degrees during several seasons. The Board of Admiralty have placed at the disposal of this expedition the depots of provisions left by Sir George Nares in Smith Sound in the years 1875 and 1876, and we shall feel an interest in seeing what our cousins on the other side of the Atlantic may succeed in doing in this matter.

ADMIRALTY SURVEYS FOR THE PAST YEAR.

BY THE HYDROGRAPHER, CAPT. F. J. O. EVANS, R. N., C. B., F. R. S.

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On the seaboard of China, Captain Napier and his staff in the Magpie, visiting the Gulf of Tong King and Hainan Island, have surveyed the Treaty-ports of Pak-hoi and Hoi-how; determined the position of Gmi Chan Island and Cape Cami, including a partial examination of the shoal ground off this headland. Proceeding northward, an extended search for the Actæon shoal was instituted; this reported danger in the neighborhood of the Shantung promontory, and lying in the highway of navigation for ships proceeding to the Gulf of Pechili, having long perplexed seamen; the search, however, was not successful. A comprehensive survey of the entrance of the Yang-tsze kiang, extending from Shaweishan Island and the Tungsha banks as a seaward boundary upward to Buch Island above the Wusung River, including enlarged plans of the outer and inner bars of this river, is also nearly completed.

In Japan, Commander Aldrich and Staff in the Sylvia have completed the Goto Islands; also the west coast of Kinsin from Da Sima to Odimari Bay, including the Kosiki group and the off-lying islands from the western part of Van Diemen Strait. A preparatory triangulation of the coast from Odimari Bay to Cape Cochrane on the east coast of Kinsin has also been made. The charts of the seaward approaches to Western Japan from the ports of China are thus approaching a satisfactory completion.

After six years service on the coasts of Japan, the Sylvia will return to England in the autumn of this year. H. M. S. Flying Fish, an armed sloop, of modern type, will take her place, under command of Lieutenant R. F. Hoskyn, this officer having taken an active part in the surveying duties on which the Sylvia was engaged during the whole of her foreign service.

On the western coast of South America, H. M. S. Alert, with an efficient staff of surveyors, in the early part of the year under Sir George Nares, and subsequently under Captain Maclear, has been employed on arduous service, chiefly in a critical examination of the ship channels adjacent to the fiftieth parallel of latitude. Trinidad channel—directly opening into the Pacific Ocean—with Conception channel leading from the inner waters north of Magellan Strait into Trinidad channel, have all been surveyed, together with their numerous ports and temporary anchorages likely to be useful to passing shipping. Innocentes channel, leading to Conception channel from the now well known Guia narrows, has also been examined and charted.

Trinidad channel opens out a clear passage to the Pacific Ocean, 160 miles to the north of Magellan Strait; and although not so secure of approach *from* the Pacific as the well known entrance into that strait by Cape Pillar and the Evangelists, it will be found a valuable addition to our knowledge of these waters, as enabling ships passing into the Pacific to avoid the heavy sea frequently experienced in the higher south latitude. Similar in feature to Magellan Strait, the ocean entrace of Trinidad channel is shoal, having only forty fathoms of water in the deepest part, the depths gradually increasing to 300 fathoms in the inner channels. The southern shores are bounded by bold, rugged mountains, rising abruptly from the sea; whilst on the northern side a low wooded country lies between the sea and the rugged spurs of distant snow-clad mountains; both shores are cut up into numerous bays and inlets. In the latter months of the year very few natives were seen; it is understood that at this season the Fuegians leave the inner waters for the outer seaboard, in pursuit of seals.

During the winter months, the Alert, having refitted at Coquimbo, then visited St. Felix and St. Ambrose islands, and obtained a series of ocean soundings in an area unexplored by the Challenger in 1875 These islands appear to be unconnected with the South American continent, for soundings obtained midway gave a depth of 2250 fathoms (rad. ooze), with a bottom temperature of 33°.5 F , both depth and temperature thus corresponding to the general bed of the South Pacific Ocean. Neither do they join the Juan Fernandez group, for the depths between reached 2000 fathoms. These several scattered lands thus appear to rise from a submarine plateau as isolated mountains. Captain Maclear describes St. Ambrose Island as volcanic, composed entirely of lava arranged in horizontal strata very marked, intersected vertically by dikes of basalt; vegetation is scanty, and the island is without water; though frequented by sea birds, the sides are too steep and rugged for guano to collect.

PUBLIC SCHOOLS' PRIZE MEDALS.

FROM THE REPORT OF THE ANNIVERSARY MEETING OF THE ROYAL GEOGRAPHICAL SOCIETY.

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The medals have been awarded this year as follows by the Examiners. who were for Physical Geography, Commander V. L. Lameron, R. N., and for Political Geography, Admiral Sir Erasmus Ommanney, F. R. S.; the special subject for the year being "Western Africa, between the Sahara, the territory of Egypt, the Equatorial Lakes, and the sixth parallel of south latitude."

PHYSICAL GEOGRAPHY.

Gold Medal—David Bowie, Dulwich College. Silver Medal—Albert Lewis Humphries, Liverpool College. Honorably Mentioned—Gustave Isadore Schorstein, City of London School; Sydney Edkins, City of London School; Phillipe Joseph Hartog, University College School; Henderson McMaster, Liverpool College; Robert Galbraith Reid, Dulwich College.

POLITICAL GEOGRAPHY.

Gold Medal—Frederick James Naylor, Dulwich College. Silver Medal—Theodore Brooks, London International College. Honorably Mentioned—Charles Theodore Knaws, Dulwich College; Charles E. Mallet, Harrow School; William H David Boyle, Eaton College; Allan Danson Rigby, Liverpool College; Matthew George Grant, Liverpool College; Charles James Casher, Brighton College.

Mr. Douglas Treshfield, said that, in the absence of Mr. F. Gation, the Chairman of the Public School's Prizes Committee, it fell to him, as a member of the Committee, to announce the result of the recent examinations. Before doing so he wished to make some remarks suggested by a tabular statement before him, showing the number of candidates who had submitted themselves for examination in each year, since the prizes were founded in 1869. Such a comparison showed rapid oscillation rather than any steady advance. In 1869 we began with 81 candidates, the number falling, in 1871 to 23. In 1876 the number rose again to 54, and this year stood at 32, which was somewhat below the average. This result must not, he thought, be looked on as discouraging. The large numbers at commencement were doubtless due to ignorance of the nature of the examination, which was not confined to the old-fashioned school topography, a mere list of names to be learned by rote, but aimed at testing the knowledge of boys in scientific geography. To prepare boys for the Society's examinations required considerable attainments in the teacher, and it is not every school, not even every public school, which is fortunate in the possession of adequate instructors. One of the results of the examinations would probably be to supply the first requisite of sound teaching—a number of competent teachers—under whom many schools might rival the successes won for Dulwich and Liverpool Colleges, under Dr. Carver and the Rev. George Butler. There was, he believed, no doubt that the importance of geography as a branch of education, was more generally recognized. Indirectly it fulfilled the first requisites of an educational subject, by inculcating at the same time accuracy in details and the habit of drawing from them broad conclusions. Whatever branch of science the student might follow up, he would find a knowledge of the conditions of the earth's surface, such as is supplied by physical geography, a staff in his hand. In the more prominent, but perhaps lower walks of life, such a knowledge was of great service. In the future, those soldiers who know best their maps, would win most battles. The merchants who best understood physical conditions would make most money, and the nation whose statesmen were scientific geographers would have the most scientific of all possible scientific frontiers. Turning to the detailed results of the last examination, he would point out that of the fifty-two schools which had been invited to compete, ten only had sent candidates. The examiners, in their report to the committee, speak very highly of the work done. Dulwich College had been most successful, securing both the gold medals, the gold medalist in physical geography having last year obtained the same position in political geography. Liverpool College was again successful, and the London International College had carried off a prize, and the City London School had obtained a creditable position.

Commander Cameron introduced the medalist in physical geography, and Admiral Sir Erasmus Ommanney, those in political geography.

The President, in presenting the medals, said with regard to Dulwich College, which had carried off both the gold medals, he would by permission of the meeting, make one or two observations regarding that institution. Having had the honor two years ago of presenting the prizes to the boys of Dulwich College, and thus becoming acquainted with the head-master, Dr. Carver had written a letter to him containing some remarks on the study of geography in schools which he thought would be of interest to the meeting. He inclosed a copy of the school list, and at the same time said: "You will see from these lists that Bowie, the gold medalist in physical geography, obtained the prize of his form in 'Form Work,' and was bracketed for the prize in 'Greek and Higher Classics' with Naylor, the gold medalist in political geography. Your Lordships will, I am sure, regard these facts as not altogether immaterial. They show at any rate that the proficiency of these boys in geography has not been attained by any special 'cramming' or by the sacrifice of their general culture to one conspicuous but passing success. To me the success of the College in the competition of the Royal Geographical Society has been gratifying, and just for this reason, because it has been obtained, not by boys making modern subjects their specialty, but by boys who were prepared to bring well trained and cultivated minds to bear upon any subject to which their attention might be directed."

To David Bowie, the gold medalist in physical geography, the President said: "I have great satisfaction in handing you this medal. A strong proof how well it is deserved is furnished by your having gained, as Mr. Freshfield has told us, last year the gold medal in the other branch of the science, political geography, and were honorably mentioned in the examination of the year previous."

To the silver medalist, A. L. Humphries, the President said: "This is the fifteenth medal gained by the school to which you belong, Liverpool College, a striking testimony to the skill and success with which geography is studied in that institution, and to the pains taken by its eminent head-master, the Rev. George Butler."

Mr. R. N. Cust, at the invitation of the President, announced the special subject of next year's examination as being "Polynesia, including New Zealand."

ARGENTINE REPUBLIC.—An importation of 101 African ostriches has succeeded at Buenos Ayres. Their owner is an Englishman, who proposes to establish a farm for ostriches in that province; the climacteric conditions, according to his opinion, favoring his project.

EXPEDITIONS.—Dr. E. Pieroth, an Italian traveller and *savant*, is now organizing an Exploring Expedition to Egypt, Palestine and neighboring countries. He intends to leave Marseilles, on the second of September, and hopes to return by November first.

CAPTAIN BOVE, of the royal Italian navy, who was associated with Prof. Nordenskjold, in his late excursion to the glacial seas of the North, has projected an Antarctic Expedition He will leave next May and be absent two years among the glaciers of the South Pole His crew and steamer will be furnished by the Italian Government, from the royal navy—at an expense of about 600,000 francs.

NECROLOGICAL.—By sad concidence geology has lost two *savants*, W. H. Willer and M. Ansted, both having died on the same day. The former was eighty years of age and author of several classic works, of which, a treatise on crystallography was the most notable. Mr. Ansted was only sixty-six years of age, and was professor of geology at King's College, London, and Examiner on geography and physics, in the department of science and art. He was an author of numerous works. Both of these individuals were educated at Cambridge and belonged to the Royal Society.

FATHER HORNER, the celebrated Catholic Missionary, is dead. He had been a resident missionary on the island of Zanzibar for many years, and was conspicuous for his labors in behalf of the suppression of the slave trade, for his African travels, and for the sympathy and assistance he was always ready to give to explorers and scientists on the Eastern African coast. He died last May, at Cannes, France.—*L'Exploration.*

A VIEW OF ÆTNA.

BY S. P. LANGLEY.

It was now December, but in spite of my haste to get on the mountain before the snows covered it, I stopped at Taormina, half-way to Catania (whence the ascent was to be made), to view Ætna from the north. Taormina is built on the southern slope of a spur projecting into the Mediterranean, whose northern ridge, rising a thousand feet above the sea, is crowned by the ruins of a Grecian theatre. The stream of pleasure-travel seems to pass by this wonderful coast, so that comparatively few tourists see the shores of Sicily, except from the steamer which takes them to Athens or Alexandria; but if the reader is among those few, he may remember the view from these ruins at sunrise as one of which the earth cannot furnish many. He will remember, perhaps, rising long before daybreak for a solitary climb through steep lanes, half seeing, half groping, his way between high walls, over which started into dim sight spectral figures with outstretched arms, resolved, as he drew nearer, into some overleaning cactus, vaguely outlined overhead against the starry sky. Mounting higher, one comes out from between the overshadowing walls into the moonlight, the waning moon, a crescent in the east, "holding the old moon in her arms," while, when higher yet, the columns of the ancient proscenium stand out against a faint glow that shows where the sun is yet to rise; till, passing by these, climbing and groping up the stone benches which once held tiers of spectators, one takes a solitary seat at the summit. Below, the last lights are still twinkling on the coast, but beyond and over the columns, all along the south, rises a dark something, which might be a hundred yards away, but is Ætna, and twenty miles distant. As the dawn grows brighter the outlook extends north and east to Italy, and as the sun makes ready to come out of the ocean the gray mass in the south moves further away, and takes on distinctness as it recedes, until we make out the whole form of Ætna, with the outline of the crater and of the snow fields about its summit. These distant snows suddenly changed their gray to a rose pink as they caught the light of the sun before it had risen to me; but of all that was seen when it came out of the ocean I was most concerned with the mountain itself, which can be viewed better here, as a whole, than from any nearer point.

The coast line on the left preserves the level to the eye, but except for this, so wide is the base of Ætna that it fills the whole southern landscape, which seems to be tilted upward till its horizon ends in the sky. I could see from here how almost incomparably larger the immense volcano appears than Vesuvius; and the actual difference is in fact enormous, the height of Ætna being (if we disregard the terminal cone of each) nearly three times, and its mass probably twenty times, that of its Italian neighbor. The entire mountain in all its substance is lava, which has built itself up in eruptions; but from this point the successive zones of vegetation are visible which in the course of ages have in part occupied its surface. Extending to perhaps a fifth of the whole actual height before me (but covering a great deal more of the foreground in appearance), is the cultivated region. dotted with villages, which shine out from a background of what we know must be vineyards and olives. The second zone is barren, and in sharp contrast with the former. It rises to perhaps two-thirds of the whole height, and its broad masses of gray are patched with moss-like spots hardly distinguishable in color, but which are really forests of oak and chestnut. All above this rose what even from my distant station could be recognized as naked black deserts, streaked here and there with snow, while above this was the terminal cone, snow-covered at the time I saw it, and with a depression at the summit from which slowly drifted a thin vapor. The railway south of Taormina runs along the coast (and is carried through cuttings on old lava streams, which here flowed down to the sea) until it reaches Catania, a city which, as every one knows, is not only built on lava, but which has been cut through and through by lava streams, and shaken down by earthquakes in recent times, and which lives from day to day at the mercy of its terrible neighbor.—*July Atlantic.*

ARCHÆOLOGY.

A POMPEIAN HOUSE.

"The house which was begun to be excavated at the celebration of the centenary of Pompeii, and is, therefore called 'Caso del Centenario,' and from which I then saw three skeletons dug out, has proved to be the largest hitherto discovered, and is of peculiar interest. It contains two atria, two trielmia, four alæe or wings, a calidarium, frigidarium, and tepidarium. It occupies the entire space between three streets, and most likely a fourth, which has yet to be excavated. The vestibule is elegantly decorated, and its mosaic pavement ornamented with the figure of a dolphin pursued by a sea horse. In the first atrium, the walls of which are adorned with small theatrical scenes, the pavement is sunk and broken, as if by an earthquake, and there is a large hole through which one sees the cellar. The second atrium is very spacious with a handsome perisytle, the columns —white and red stucco—being twenty-six in number. In the center is a large marble basin, within the edge of which runs a narrow step. On the pedestal at one side was found the statuette of the Faun which we lately described. The most interesting place in the house is an inner court or room, on one side of which is the niche, with tiny marble steps, often to be seen in Pompeian houses. The fiescoes on the walls are very beautiful. Close to the floor runs a wreath of leaves about a quarter of a yard wide, with alternately a lizard and a stork. Above it, about a yard distant, droop, as if from over a wall, large branches of vine or ivy and broad leaves like those of the tiger-lily—all freely, naturally and gracefully drawn. At each corner of the room a bird clings to one of these branches. Then comes a space—bordered at the top by another row of leaves—in which is represented a whole aquarium, as if the room were lined with tanks. There are different sorts of shells and aquatic plants lying at the bottom of the water, and swimming in or on it all kinds of fish, jelly-fish, ducks and swans, admirably sketched with a light yet firm touch. The ripples made by the swimming ducks are indicated, and one duck is just flying into the water with a splash. On each side of the niche this amusing aquarium is enlivened by a special incident. To the left a large octopus has caught a monstrous muræenal (lamprey)—which turns around to bite—in its tentacles; to the right fine lobster has pierced another muræenal through and through with its long hard feelers or horns. These creatures are painted in the natural colors very truthfully. On the left wall above the fishes, are two sphinxes, supporting on their heads square marble vases, on the brim of each of which sits a dove. Behind the niche, and on the left side of the room, runs a little gallery with a corridor underneath, lighted by small square holes in the border of hanging branches. The wall of this gallery behind the niche is decorated with a woodland landscape, in which, on one side, is represented a bull running frantically away with a lion clinging to his haunches; on the other, a horse lying struggling on his back, attacked by a leopard; all nearly the size of life. On each side of the doorway is painted respectively, a graceful doe and a bear. The other rooms are also very beautiful; one with a splendidly elegant design on a black ground; in another a small frescoe representing a man pouring wine out of an amphora into a large vessel. The bathrooms are large and elegant, the cold bath spacious and of marble. In one room a corner is dedicoted to the *lares* and *penates*, and in the fresco decoration, among the usual serpents, etc., I noticed the singular figure of a Bacchus or bacchante, entirely clothed with large grapes. In one of the mosaic pavements is a head of Medusa, the colors very bright and well preserved. As some of the ruins are only excavated to within two or three feet of the floor, it is possible that many valuable ornaments or statuettes may yet be found, as everything indicates that this splendid house belonged to some rich citizen."—*London News.*

INTERESTING DISCOVERIES IN CLINTON COUNTY, OHIO.

Ever since archæologists began the study of the origin, habits, mode of living and cause of the mysteriously complete disappearance of that strange race of people which we moderns call "Mound Builders," the absence of any pictured or written record from their hands has proved the rock in the way which stopped all further inquiry, almost at the entrance door to their charmed history. Thoroughly scientific and able men have studied the subject carefully and closely from the basis of the discoveries made of earthworks, utensils, weapons and ornaments, and after years of patient work have published their theory of the matter to the world. Other men, with as great learning and ability, have followed in their footsteps and evolved other and contrary conclusions from the investigation of similar facts; they, in turn, to be followed, year after year, by still others with constantly varying opinions, until the manifold theories put forth in regard to the "entrance" and the "exit" of this extinct race have become a maze which leads in every direction, but centers upon no one point. All these theorists, however, are agreed that were any written characters or hieroglyphics of the Mound Builders to be discovered it would contribute in a marvelous degree toward the clearing up of the mystery. Short's "North Americans of Antiquity," a work published as late as the present year, says: "No well authenticated Mound Builder hieroglyphics have yet come to light." Clinton county is rich in remains of the Mound Builders, and our archæologists believe that they will yet supply the hiatus necessary to establish the identity and trace the race origin of the early rulers of America. More than a year ago Mr. Jonathan Richardson discovered in a mound in this county an engraved tablet-stone and a "butterfly relic" bearing hieroglypics, both of which were first noticed and described in the Cincinnati *Commercial.* They were afterward photo-lithographed and description and engravings issued in pamphlet form.

Now comes another discovery which is as important as any yet made. Mr. Jonah Frazier, a farmer, residing some four miles north of Wilmington, and in the vicinity of an old deer "lick," while spading in his garden on Friday evening last, unearthed a stone pipe of curious construction, which he yesterday brought in for inspection by your correspondent. The pipe is fashioned from the the stone known as Clinton rock, two or three specks of iron pyrites being visible, hard as flint and shaped like a rubber ball flattened by compression, its greatest diameter being 2¾ inches and its thickest 1⅜ inches. It is elaborately and artistically carved, being really a fine piece of workmanship. In a circular depression, filling the space of one of its sides, is a bas-relief (front view) of a human face with high cheek bones, wide, straight mouth, flat nose, full lips, low, broad forehead, and the entire facial features, indicative of the presence of craft, cunning and intelligence struggling for the mastery. It is not the face of an Indian, nor such a one as an Indian could have imagined. On the opposite side of the pipe is a hollow, fitted to the ball of the thumb when in position for holding the pipe. Through one side, and just above where the stem should be inserted, is drilled a hole, evidently intended for the reception of a string by means of which the pipe could be suspended around the neck of its owner, or upon the wall of his dwelling. On the front of the bowl—being the side farthest from the smoker when the pipe is in use—is an oblong sunken space in which is carved the outline of a beaver, its head toward the upper part of the bowl. But the main point of interest in this relic, and that which gives it its greatest value, consists in a series of hieroglyphics beginning just below the face and extending around the under side of the bowl. A quarter of an inch below the circle which incloses the face is a character fashioned like the figure 8 laid upon its side, with the two inclosed spaces filled with curious characters, and its right end adorned with a cresent shaped mark with the horns turned outward. Beneath this are other characters in some respects bearing resemblance to those of the Maya language. One is shaped like a wheel with four spokes; another like the letter G, with three dots inclosed, and a branch with twigs, shooting from its upper side, while others take on shapes the like of which we have never seen before.

May not these little figures prove to be the lever that shall unravel the mystery which surrounds the history of that race whose footprints on this continent are so strongly outlined and yet so inexplicable, and set at rest the floating theories in regard to their origin which have been so contradictory and unsatisfactory? Mr. F. has been offered a considerable sum of money for his "relic," but refuses to sell. It is now temporarily in the possession of Dr. L. B. Welch, of Wilmington, a well known experienced archæologist.*

* Referring to this discovery we call attention to the following note by a well known writer who sends us the article —[Ed.

THE ANTIQUE PIPE FOUND IN CLINTON COUNTY.

To the Editor of the Review:

I notice an account in the Commercial of a pipe recently found in Clinton County, and compare the figures you engrave as *fac similes* of those on the pipe with those in the third and fourth volumes of Lord Kingsborough's "Antiquities of Mexico." Is there any good reason why the theory may not be sustained that all the specimens of sculpture so numerous in the Mississippi Valleys may not have been the product of the people inhabiting Mexico at the time of the conquest of that country by Cortez? The Indians made none of them, but received them all in the way of trade from the far more cultivated race of Mexicans. The specimens of pottery found on the banks of the Ohio are all of a nature similar to those found in Kingsborough's great work, and were received by the Indians. That many of them were deposited in mounds was, of course, natural, as they are also found all over Eorope in similar mounds, constructed by the Scythians and other barbarous people. See Martin's History of France and Thierry. Similar specimens of sculpture are also found now in the Canary Islands. Why do not the facts properly suggest that the artists belonged in all cases to the same race, and that this race found its way to the American Continent, by way of the Canary Islands and the East Atlantic Islands that once stood where now is found the Sargosso Sea? That portion of the race that had reached Mexico before the sinking of the lost Atlantis became isolated from Europe and was in the plenitude of its civilization when Cortez discovered it and ended its career by conquest. This race naturally spread all over the American continent, taking full possession of South America, where Peru was the center of power. In advancing to the North it met the Indians, who had come from the north of Europe by way of Greenland

and from Asia by way of Behring Straits. The Indians remained masters of the North, while the Mexicans perfected their civilization in the South. Had Cortez worked as hard to discover history as he did to plunder the people of Montezuma, he was in a condition to have had his labor rewarded with some of the most astounding developments of all antiquity. But the old scoundrel b rned, destroyed, exterminated every link he found, as far as possible, and we now have a few relics with nothing but guess work as to their meaning. Everything found now should be preserved with "religious" care, until the key to the meaning of hieroglyphical characters is at last found, and the mystery of the Aztecs and the Indian race cleared up. ANTIQUITAS.

THE ORIGINAL SETTLERS OF AMERICA.

A deep interest is taken in the explorations about to be made in Mexico and Central America, in order to bring to light the lost history, skill, inventions, arts, genius and science of the unknown races who lived, died and passed into oblivion on this continent. Many remains have been discovered, but much still remains to reward the antiquarian, the historian, and the friend of humanity.

One link needs perfecting. The Aztec antiquities now on exhibition in the Metropolitan Museum of art are nearly similar in design to those discovered recently in the Isle of Cyprus. It may possibly be shown by further discoveries that the same race of men who inhabited Cyprus struck America 1400 or 1500 years before the Christian era. This discovery will show that the Phœnicians, Carthaginians, or Egyptians colonized America.

America is an old country. It is an error to say it was discovered by Columbus. That was only a restoration of the knowledge lost by a certain portion of the world, through timidity, fear, and a want of skill in navigation. What had been known to millions was no discovery. People talk of the discovery of glass and the circulation of the blood as something new. The Phœnicans and Plato knew of them thousands of years ago. There is a strong probability that America was partly colonized by the Phœnicans, Carthaginians, and Egyptians.

In the elaborate article in the SUN on this subject you are right in speaking of American civilization as dating back to the beginning of Assyrian history. If it can be shown that American antiquities are similar to those of the Phœnicians and Carthaginians, then the race of Cham and not of Sem originally peopled America. The same race colonized Spain, Ireland, France, Italy, Sardinia, Sicily, and the Balearic Isles in the Mediterranean.

In calculating the increase of population after the deluge, we may recall the fact that seventy souls among the Jews went down to Egypt; in the course of 215 years they numbered nearly 3,000,000. Still further, the Phœnicians having planted small colonies in various countries, these grew into nations.—*Cor. N. Y. Sun.*

FOREIGN CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

June 18, 1880.

French alienists consider "hallucination" as a perception without an object, and "illusion" as a real perception falsely interpreted. In both cases the result is due to united physical and mental causes, that is, the commencement is a physical sensation. An ancient and famous philosopher maintained that the entire universe was only a gigantic hallucination. People are not necessarily ill or mad because laboring under an illusion; at a distance a square tower may appear round, owing to perspective modifying the apparent forms of objects. In the eyes of a maniac, linen suspended from a line becomes hanging corpses; images floating in the air, appear balloons directed by aeronauts. Laseque defined, that illusion is to hallucination, what slander is to calumny. With lunatics at least, it is the ear which occupies the first rôle in cerebral troubles; they hear the sound of footsteps as of a person walking in another room; or some musical notes, musketry fire, or the reports of cannons. But there is an abyss between the pa ient who hears only sounds, and him who listens to words, the latter at first in monosyllables, then becoming phrases, and finally sentences, till the afflicted indulges in replies, and terminates by believing he is in presence of a distinct personality who encroaches on his existence. Such is the meaning of the "possessed" of the Middle Ages, and later of the seventeenth century. It is thus that the exorcists charged to deliver the Ursulines of London from the diabolical spirits of which they were possessed, became in several instances themselves the victims of the epidemic. Sight also plays a conspicuous rôle in hallucinations, producing alcoholic night-mares, and unceasing terrifying visions. The sensitive apparatus is composed of extremities which receive the impression; the tube which transmits it, the ganglions which receive and condense it, then those cellules of the hemisphere of the brain which perceive it, and that represent matter in its highest expression of relationship with intellectual fuctions—and where alone phenomena can be judged. The deaf, strange to say, suffer from hallucinations of hearing, as well as the blind from those of seeing. Certain physiologists maintain, that we ought never to forget anything, because the cerebal cells always remain filled with impressions, though in a latent state, and that there is a mystical power, independent of our will, at work, ready to call up these forgotten sentences. During a conversation, we may suddenly forget a name or date; next day when the circumstance has passed away, the wanted name or date will surge up. What is that automatic, mysterious secretary that has been working for us independent of our will? J. J. Rousseau, when conversing, was heavy and embarrassed, and it was only on arriving at the foot of the staircase that he discovered the witty reply that he ought to have made in the drawing room. Often when at school, the lesson imperfectly learned during the evening, becomes well engraved in the memory on our awakening. The mind has worked for us during sleep, but we were unconscious of its acts. In antiquity, visionaries saw appear the black Eumenides or the divine Apollo; mythology is now replaced by the Virgin and the saints, and it is a fact well known to alienists, that the delirium and hallucinations of Catholics differ essentially from those of Protestants. Van der Kalk remarks, that it is by the left ear that patients who are possessed, assert they hear Satan speaking to them, while another patient claiming to be in relations without a good and bad spirit, at once invariably received whispers of vice by the left, and counsels of virtue by the right, ear.

The sun has become a subject of very popular study; naturally we ought to be interested in the rays of a star on which life hangs. The sun is the heart of the planetary organism: each of its pulsations spreads vital force not only to our earth, some thirty-seven millions of leagues distant, but to Neptune 1,100 millions of leagues away, also to the pale comets abandoned to an eternal winter, and still farther, to stars millions of milliards more distant still. This force emanates incessantly from the sun's energy, and is distributed around into space with marvellous rapidity; eight minutes suffice for light to bound to us from the sun, at the rate of 75,000 leagues per second. The sun is 108 times larger in diameter than our earth; 1,279,000 times more voluminous, and 324,000 times more dense. The highest dome in the world is that at Florence erected by the genius of Brunelleschi; it is about forty-nine yards in diameter, the dome of the Pantheon of Paris is but twenty-three yards, yet the latter and a bullet eight inches in diameter, would represent the relative magnitudes of the sun and our planet. In other words, suppose the sun placed in a scales, it would require 324,000 earths to make the scales turn. The planets that revolve 'round the sun resemble so many toys, yet sun and stars themselves are only atoms of the infinite. The moon gravitates around the earth, and the earth around the sun, while the sun whirls the planets and tneir satellites toward the constellation Hercules, and these movements are executed with a rythm and exactitude, following determined laws, as the hands of a watch turn on the pivot or the concentric circles that ebb away on the surface of a pond when a stone is thrown therein. All is movement, vibration, harmony. In violet light the atoms of ether oscillate at the rate of 740 milliards of vibrations per second; red light is slower, its vibrations in the same time are about 380 milliards; the color violet, is in the order of colors, what the highest note is in the order of sound; red represents the lowest color, or base note. An object floating on the water obeys the ripples or waves which arrive from various sides, so the atom of ether undulates under the influence of heat and light, the atom of air under the influence of sound, and the planet and the satellite under the influence of gravitation. To comprehend the distance of the Earth from the Sun, were a cannon ball to travel at the rate of 550 yards a second, it would require nine years and eight months to reach the sun. Again the Sun is the center of most astounding conflagrations and explosions. If the space between our planet and the Sun could transmit the noise at the usual rapidity of 374 yards per second, the sound would necessitate some fourteen years to arrive to us. A train traveling at the rate of thirty-eight miles an hour, would require 266 years to reach the Sun. A vogager who left at that rate of traveling during the reign of James I., would only be due at his destination to-day.

The Sun is the source from which flows all the forces that put the earth and its life in motion, it is the Sun's heat which causes the wind to blow, the clouds to rise, rivers to flow, forests to grow, fruit to ripen, and man himself to exist. This united force, constantly and silently, exercised to raise the resevoirs of rain to their mean atmospheric height, to fix carbon in plants, to give to terrestrial nature her vigor and her beauty, is estimated in a mechanical point of view, to be equal to 543 milliards of steam engines, of 400-horse power each, working day and night incessantly. It is the Sun's heat which maintains matter in its three states, solid, liquid and gaseous. Examined through a powerful instrument, the surface of the sun appears to be covered with small grains of different forms, but where the oval predominates, the interstices which are very free. form a kind of gray net-work, the knots of this net-work enlarge sometimes as to form pores, which increasing still, give birth to a "spot." The luminous surface of the Sun has been called *photosphere*; it is not uniform but composed of a multitude of luminous points, disseminated on the somber net-work. These points or grains, produce the heat and light that we receive from the Sun, and occupy about one-fifth part of the surface of that star; if they approach closer to each other, multiplying and condensing, the dark netting would disappear, the light would be increased from two to five fold, and the heat in proportion; were they on the contrary to diminish, light and heat would disappear, and the world expire from cold. We call flame and fire all that which burns, but the gases in the Sun's atmosphere possess such an elevated degree of temperature that it is impossible for them to burn. Occasionally protuberances are visible round the sun; these are due to explosions of hydrogen, which shoot that gas upward at the rate of 244,000 yards in a second; these eruptions continue during several hours, often days, motionless as immense luminous clouds, when they fall down in showers of liquid fire. These phenomena are hurricanes; now a hurricane of the greatest intensity on our planet, does not travel at a greater rate than 100 miles an *hour*, the fire-hurricane travels that space in a *second* Vesuvius has entombed Pompeii and Herculaneum beneath its lavas. A solar eruption shooting up flames to the height of 63,000 miles in a few seconds, would bury our earth under its shower of fire, reducing terrestrial life to ashes in a shorter space of time than is required to read these lines.

Messrs. Richet and Mourrut have conducted a series of experiments at Havre on digestion with fishes; with the latter, as in the case of other classes of vertebrata, there is a very great diversity in point of intensity of digestion; pending the process of digestion, the stomach is very acid, and the contrary when the stomach is empty; the gastric liquid acts more powerfully the less it is pure; temperature augments the digestive process, and while the gastric juices do not at all affect starch, they rapidly transform fibrine.

Messrs. de Fonvielle and Lontin have produced a new and elegant form of electro-magnetic rotation, very ingenious, and that will be an addition to lessons in physics. The apparatus consists of a galvano-metric frame, in the center is a piece of iron on a pivot, which is polarised by a magnet, fixed on the exterior of the frame. When the electric current traverses the galvano-metric spirals, the piece of iron revolves with a grand rapidity. The principle is not novel and depends on the difference in intensity of the alternative currents. The latter if produced by a Gramme machine, and made intermittent, will serve equally well.

M. Lichtenstein has placed the insects, which produce the gall nut, in some tubes, in time they deposited young insects, which perished, as he did not know their peculiar food. He observed that during August other insects replaced those that had left the gall nut, and produced young, the latter disappearing in the tender twigs of the (poplar) tree, forming thereon a kind of pad.

Asparagus, the variety white stems and purple heads, is a favorite spring dish in France, and the Italians in their love for that comestible are surpassed by the French. The market gardens of Argenteuil eclipse those of Ravenna. Does asparagus exercise a nutritive action? It is doubtful; it contains a little phosphate of lime and potash. However, it is a very light and agreeable aliment, admirable for convalescents, on condition that the sauce suits their stomach. Asparagus excites the appetite and has a diuretic action. The root of the plant is employed against jaundice and affections of the bladder, it relieves, according to some hypertrophy of the heart. It is employed as a calmant by others, as it does not irritate the stomach, like digitalis; it is bad for those recovering from articulated rheumatism; there are authorities who profess asparagus will cure hydrophobia. As a curative agent it may be safely concluded to have no effect.

Dr. Delpech demands that rearing bees on the outskirts of the city be prohibited. Several fatal cases of stinging have occured, especially in the face, the neighborhood of the nervous centers, where the blood, changed by the venom of the sting, rapidly decreases the activity of the nervous system, thus suspending the functions essential to the maintenance of life.

In the Cevennes, sheep are largely reared for their milk, which is made into cheese, the Roquefort being the most celebrated; even in the time of Pliny the sheep cheese of Lozēre (Luzara) was famous,and was sent from Nismes to Rome. Two curious facts to note in connection with this breed of sheep, reared for milking purposes; many have four nipples, cases occurring of yielding milk by each, and the ordinary two teats are very voluminous.

M. Toussaint has studied the subject of phthisis in pigs, and finds that it is hereditary, and can be contracted by the progeny while sucking, by inocculation or co-habitation. The disease resembles galloping consumption in human beings, and brings about death in a few weeks. In sheep the malady takes a chronic form.

BOOK NOTICES.

LIPPINCOTT'S PRONOUNCING GAZETTEER OF THE WORLD: pp. 2478 large Octavo: J. B. Lippincott & Co., Philadelphia 1880. For sale by H. H. Shepard. $10.00.

It is difficult adequately to conceive of the vast strides made in geographical knowledge within a few years, except by comparison of old works with new ones, and this will be found an especially truthful statement by the student who compares any Gazetteer more than five years old with that recently published by J. B. Lippincott & Co. He will find that it now takes nearly 2500 pages, double column, fine print, to describe what was fully described a few years since in far less space. He will also be surprised to learn not only that many new and important places have sprung into existence and become important commercial centers, but that so many which were in former editions mentioned as thriving cities and towns, even in our own country are now utterly abandoned and unknown. It is astonishing to see how perfectly the work under consideration has been made up. It not only contains recent and authentic information respecting the countries, islands, rivers, mountains, cities, towns, &c., in all portions of the globe, but it actually gives an account of more than one hundred and twenty-five thousand places, with correct spelling and pronunciation indicated in all instances. We have been surprised and have quite surprised several friends, by the extreme minuteness of the information contained in this work as well as by its extent. Of course, to secure such perfection a vast amount of labor has been expended in consulting similar works in all languages, books of history and travel, official documents, and by a most extensive private correspondence all over the globe.

In addition to the vastly increased number of places noticed, such particular attention has been paid to orthography, pronounciation, ancient and modern names of places and signification of geographical names as to render them characteristics of the work.

For public libraries, schools, teachers, and all persons requiring books of reference, this is a book of sterling value and of the most reliable character.

FIRST ANNUAL REPORT OF THE DEPARTMENT OF STATISTICS AND GEOLOGY OF THE STATE OF INDIANA. 1879, pp. 514, Octavo: Indianapolis, Douglass & Carlin, 1880.

It is a little singular that at this late day the State of Indiana is publishing her first Report of this kind. With her exhaustless resources of almost every kind it would naturally be supposed that they would have been long years since made known to the world in every practicable way.

But though late in beginning, the work has been well done, and no one can read this Report without acknowledging that the facts compiled have been judiciously and forcibly set forth and that great credit is due Professor Collet and his assistants for industry in collecting and skill in preparing them. The general description of the State with which the volume commences, and the statistical tables which follow, furnish the most complete and satisfactory account of the progress of the State in agriculture, manufactures, trade, finances, education, religion, population and hygiene that could be desired and just such information as the immigrant needs.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, FOR MARCH, APRIL AND MAY, 1880: pp. 152 Octavo, illustrated.

This Society, which has been in existence since 1817, still keeps up its active work and this volume contains the results of the original researches and investigations of some of the best known naturalists in the country; such as Leidy, Meehan, Lockington, Heilprin, Kingsley, Allen, Bergh, Redfield and Kelly, and is illustrated copiously.

Dr. Ruschenberger is President, Prof. Thomas Meehan, Vice President, and Prof. Jos. Leidy, M. D., is Chairman of the Publication Committee and Edward J. Nolan, M. D., Editor.

ENGINEERING PROGRESS IN THE UNITED STATES: By Octave Chanute, C. E: pp. 40, Octavo.

This is the annual address for 1880, read by Vice-President Chanute (formerly our fellow citizen) at the twelfth Annual Convention of the American Society of Civil Engineers, held at St. Louis, May 25th, 1880

The paper is a condensed and at the same time comprehensive review of engineering and engineering inventions in this country; taking up consecutively the principal points of interest in connection with Water Works, Hydraulics, Canals, Street Railways, Bridges, Preservation of Timber, River Improvements, Light Houses, Marine Engineering, Telegraphic Engineering, Gas Engineering, Metallurgy and Mining, Agricultural Engineering, Transportation of meats and the Engineering Future.

It is concisely written, but possesses great interest, and will doubtless furnish to future numbers of the *Review* some valuable chapters.

THE STUDY OF LANGUAGES Brought back to its True Principles: By C. Marcel, pp. 27, Quarto: J. Fitzgerald & Co., N. Y. For sale by the K. C. Book & News Co.; 15 cents.

This is number eight of the Humboldt Library, and like its predecessors is a shining example of a good thing in cheap literature. M. Marcel is the author of "Languages as a Means of Mental Culture" etc., and has had large experience as a teacher. This work is a brief summary of a larger work not yet published, but in it are given special directions for the acquisition of ancient and modern languages by learners of all classes. It is divided into chapters upon Subdivision and order of study, The Art of Reading, The Art of Hearing, The Art of Speaking, The Art of Writing, Mental Culture and Routine, and covers the ground fully in each instance.

OTHER PUBLICATIONS RECEIVED.

A Record of the Progress of Astronomy during the year 1879, by J. L. E. Dreyer, M. A., of the Observatory of Trinity College, Dublin, Ireland; 47 pp. Octavo :—No II. and III. of the Publications of the Missouri Historical Society of St. Louis, being the Recollections of a Septuagenarian, by Wm. Waldo Esq., 22 pp. Octavo :—The Eleventh Annual Report of the American Museum of National History, Central Park, N. Y. : 33 pp. Octavo :—Annual Report of the Board of Directors of the Chicago Astronomical Society and Dearborn Observatory, 1880 (illustrated) 16 pp. Octavo :—Circular of the Horological and Thermometrical Bureaus of the Winchester Observatory of Yale College, New Haven, June 1880, 8 pp. Octavo.

SCIENTIFIC MISCELLANY.

DOCTOR TANNER'S FAST.

At noon on June 28th, Dr. S. H. Tanner, of Minneapolis, Minn., commenced at Clarendon Hall, New York City, an attempt to abstain from all food for a period of forty days. It appears that there had been some controversy between Dr. Tanner and Professor W. A. Hammond and other members of the New York Neurological Society, upon the subject of the length of time that the human system could endure total abstinence from food, and that the Professor had made Dr. Tanner an offer of one thousand dollars if he succeeded in living without food for forty days. This proposition, in consequence of a mutual misunderstanding, was subsequently withdrawn and the Doctor has been conducting the experiment at his own cost and risk.

Dr. Tanner is about forty-nine years of age, weighed at the commencement of his fast, 157½ pounds, and is of a rather nervous temperament. He has been vigilantly watched at all times, but especially so since the ninth day, when a detail of members of the Neurological Society was made for the purpose.

For the first few days, owing to the newspapers being filled with exciting political news, the dispatches were very meager, but as the time has progressed, and the termination of the experiment has approached, the public interest in the case has been very marked and is daily growing in intensity. At the end of the fifth day he had lost in weight about ten pounds, or an average of two pounds a day.

On the seventh day his temperature was 98½° Fahr., and his pulse 96, soft and compressible. The skin was moist and healthy, the countenance pleasant, and without the usual appearance of anxiety that follows long fasting, and the eye clear and unwavering, with normal dilatation of the pupil. The tongue was moist and slightly furred, but not more so than would naturally follow twenty-four hours' privation of food. His conversation was deliberate and coherent, but a little languid. The dimunition in the excretion of urea was surprising, as determined daily by Dr. Van Der Weyde.

On the ninth day his temperature was $98\frac{3}{10}$° and his pulse 96. On the 10th day some interesting experiments were made by his watchers about 9 o'clock to determine whether or not his sensibility was diminished. The æsthesiometer was employed, an instrument consisting of two sharp points which are arranged at right angles to a graduated scale, upon which they can be moved backward and forward. This was applied to Dr. Tanner's feet, legs, hands and arms. He was almost invariably able to tell whether one point or two had been applied, even when they were very near together. He distinguished distance as small as three-eighths of an inch, and the opinion of the physicians was that his sensibility was not diminished.

On the eleventh day he succeeded in regaining some of his lost sleep, and his face looked a little less pinched and haggard, and his voice was clearer and stronger. At noon Dr. Harwood made a careful examination. The tongue was found slightly coated; pulse 88; temperature, $98\frac{3}{5}$°; respirations, 14. The weight as taken that day was 139¾ pounds, showing a loss of about seventeen pounds. His legs and arms appeared comparatively plump and full. About eight o'clock Dr. Gunn tested his strength and sensibility with the dynamometer and æsthesiometer and detected nothing abnormal.

Dr. Maurice N. Miller, of the University Medical School, watched Dr. Tanner during three days as a scientific observer. He made a number of analyses in the college laboratory which convinced him that Dr. Tanner had taken no food. After carefully ascertaining the amount of urea in Dr. Tanner's bodily fluids, he pronounced him to be really fasting. On the 13th day he said: "To-day has tended to increase my conviction that the Doctor can not last another week. To me he seems unquestionably more feeble to-day than yesterday. His temperature is very high and the back of his neck and head is exceedingly hot and feverish. This indicates an excessive amount of nervous wear and tear, which, of course, results in exhaustion of the nervous system."

On the thirteenth day his temperature was 97¾° and his pulse 90 at 8 a. m. At 6 p. m. his pulse was 96, temperature $98\frac{8}{10}$°, respiration 14. By the dynamometer test it was shown that he had not yet lost any muscular strength.

On the fifteenth day the temperature was 98°, respiration 15, pulse 107, weight 133 pounds. Much of his time is spent in dozing and rinsing his mouth with water, which he ejects at once. He complained of cold and seemed drowsy and sluggish.

Entering on the eighteenth day of the fast, Dr. Tanner exhibited a marked improvement. From nine o'clock last night until noon the Doctor swallowed between thirty and forty ounces of water. His weight this morning was 137½ pounds. Allowing one pound for the weight of the coat, he has gained four pounds since Wednesday. He took a drive to Central Park in the morning, and forced the dynamometer up to 151, against 80 yesterday. His pulse when last taken was 80, temperature $98\frac{2}{5}°$, and respiration 16.

His condition was unchanged in the afternoon. He went out for a drive to-night. His pulse was 76 and temperature $98\frac{4}{5}°$. He forced the indicator of the dynamometer up to 166 pounds, showing a slight increase in strength. During the past twenty-four hours he drank seventy ounces of water and felt better for it.

Dr. Chas. S. Tuttle stated that during the experiment up to the eighteenth day one of the attending doctors and himself had both made five chemical analyses, and both had failed to discover the least indication of any nourishment having been taken.

On the nineteenth day his pulse registered 82, respiration 16, temperature $98\frac{2}{5}°$, weight increased to 136½ pounds, although he had taken but twenty-eight and one-half ounces of water in the twenty-four hours.

Dr. Tanner entered upon the twentieth day of his fasting in good condition, pulse recorded at 84, temperature 99°, and respiration 16; weight 135½ pounds, showing a loss of half-a-pound in the twenty-four hours, although he had taken twenty-two ounces of water.

On the twenty-first day his weight was 135 pounds, pulse 82, temperature 99½°, respiration 16, while the watching physicians agreed that his physical and mental condition indicated a decided improvement over that of a few days before and that he did not have the air of one whose vital forces had suffered much loss.

On the twenty-second day his weight was 134 pounds, pulse 72, temperature 99°, respiration 15.

On the twenty-fourth day, pulse 75, temperature 98°, weight 132, respiration 15. Manner bright and lively.

On the twenty-fifth day he complained of vertigo and nausea in the morning, but at noon was feeling better. Pulse 72, rather weak and more compressible, temperature 98¾°, respiration 16.

On the twenty-sixth day his watchers agreed that his appearance was worse than at any time before and his manner of walking was heavy and languid though he made a strong effort to appear vigorous. The pulse was found to be 80, temperature $98\frac{2}{5}°$, respiration 16; weight 131½ pounds. He expressed the opinion that water was distressing him and declared his intention to drink less of it for the future.

On the twenty-seventh day his symptoms remained much the same; nausea and heartburn, with great thirst. His pulse was 76, temperature $98\frac{3}{5}°$ and weight 130½ pounds.

Dr. Miller said: "I form my ideas in regard to the Doctor more on my private chemical analysis than on anything else. I have found that for the last few days the waste of poisonous matter from the system has been steadily decreasing, hence this poison must be accumulating in the body and will inevitably lead to blood poisoning."

On the twenty-eighth day the evidences of nervous and muscular prostration were more apparrent than on the day before and his stomach was too irritable to retain water. Pulse 74, temperature $98\frac{2}{5}$°, respiration 16, weight $129\frac{1}{4}$ pounds.

On the twenty-ninth day all his symptoms were more favorable. Pulse 84, temperature $98\frac{8}{10}$°, respiration 14, weight 130 pounds.

On the thirtieth day everything favorable.

On the thirty-first day the symptoms were decidedly alarming and indicative of speedy collapse.

On the thirty-second day, however, there was some improvement. Pulse 72, temperature $98\frac{3}{5}$°, respiration 15, weight 127.

The history of this case is very remarkable, for while other cases are upon record where the fasters are reported to have abstained from food as long as Dr. Tanner, and some even longer, this is perhaps the one in which the greatest pains have been taken by really scientific men to prevent imposition and to note all the conditions, at regular intervals. And it must be admitted that most of the symptoms in this case have been quite different from those expected and predicted by the skillful physicians in attendance, as well as those taught by our best physiological authors. The temperature of the body in particular, instead of being materially lowered, in accordance with medical teaching and experience, has remained nearly normal; while the pulse and nervous system, since the first ten days have been regular and healthful in action. The weight too has been far less reduced than any one could have expected.

Of course there is room for suspicion that food has been supplied in some unknown manner, but the probabilities in favor of this manner of solving the problem are very few indeed, and we must turn to some other source for an explanation of the facts.

THE HUDSON RIVER TUNNEL.

This is one of the greatest undertakings of modern engineering science. The tunnel has been carried a little more than 300 feet from the great well at the foot of Fifteenth street, Jersey City, or about 200 feet out under the river. The work of sinking the well on the New York side is soon to be begun near the foot of Morton street, whence the laborers will bore westward under the river and eastward to a point near Broadway, where the New York entrance will be. The rate of progress on the New Jersey side will soon be about eight feet a day, bu on the New York side, where they must penetrate about a thousand feet of rock, the progress must necessarily be slower. Operations are continuous, night and day, seven days a week, there being three sets of laborers, relieved every eight hours. Only one tunnel has been begun. There are to be two. Originally it was planned to bore one enormous tunnel, and on both sides of the river there will be one tunnel down within 200 or 300 feet of the banks of the river. Thence under the river there will be two tunnels—one for trains into the city, and one for trains from the city. Each tunnel will be about twenty-two feet in height by twenty feet in width in the clear, and circular in form. The outer shell of the tunnels is boiler iron, breaking joints and firmly riveted together, and within this iron tube will be a two foot wall of hard burnt brick, laid in cement, and extending completely around the interior, presenting the form of an arch against any outside pressure, whether vertical or lateral. The track for railroad trains will lie about forty feet below the bed of the river, and near the New York side, where the depth of water is about sixty feet; the traveler in a car under the Hudson will be about 100 feet below the vessel overhead. The company's officers say that they can dispatch 400 trains through the tunnel every twenty-four hours. The engineers vary very widely in their estimates of the cost of the enterprise, some fancying that the $10,000,000 capital will complete the work, and others that it will cost as much as $17,000,000. The company expect to complete the work about three years hence.—*K. C. Times.*

PERIHELIA.

People will discuss the wonders of the universe, and just in proportion as the phenomena are mysterious will they see signs and believe in the occult influences of the stars. And just now the perihelion of the four great planets, Jupiter, Saturn, Neptune and Uranus, is a source of vague dread to millions of people. It is true they are approaching their nearest position to the sun, and what is to be in that regard has not happened in eighteen hundred years. But history furnishes nothing coincident with similar occurrences to cause any dread now, though we must conclude that the influence which must be exerted between sun and planets to keep them in their places and govern their movements, will be more intense in action when nearest together, than when separated by the tremendous distances of the outer boundaries of their orbits. Neptune, the most distant of all the planets from the sun, requires 164 years to complete its circuit, while Jupiter requires less than one-twelfth of that time.

But, then, similar stellar perihelia as to other planets have occurred, the last one of any note being in 1708, and following years. But this was not marked by any unusual phenomena, and there is no reason to suppose it will be so in the case of these four. The distances of Uranus and Neptune and in fact both the others are so great as to preclude the supposition that the influences from them will be any m re marked than in like positions of inferior but nearer planets.

There is, in fact, nothing upon which to ground apprehension or to find cause for any baneful results from these planetary conjunctions, or that they even exercise a sway upon the meteorological conditions of our earth, Their perturbing force seems limited to a slight alteration of the elliptical orbit of the earth, and beyond this they do not appear to affect our little world, but, like all large bodies toward small ones, are complacent and kindly disposed.—*K. C. Journal.*

MINING AFFAIRS IN ARKANSAS.

The traveling correspondent of the New York *Mining Record* has been investigating mining affairs in Pima county, Arkansas, and arrived at the conclusion that mines there are well worth owning, both gold and silver being found in goodly quantity. Writing from Dos Cabesas, he says: I went on top of the main mountain that I believe is as full of gold as a mountain can well be, and it was no fool of a job. It was a mountain "as is a mountain," so steep that I left my mule at various points, and when I did attempt to ride him the same was of short duration, and it was harder to lead him than it was to do the walking. Prior to my ascension, I visited the Greenhorn, depth ten feet, with $70 gold assay; Bear Core, depth seventy feet, silver, $90 per ton; Ewell Springs, sixty feet, average, silver, $30 per ton; Jumper, eighty feet, silver, with remarkable assays. On the top of this mountain, I found lead after lead pointing to and reaching the top; they are well defined and wide. Blind Tom could almost see them. Float matter could be picked up almost anywhere near the summit. By my guide I was told to select a piece, and he would "horn spoon" it for me. I did, and did my level best to make the worst selection I possibly could; I took a piece of rock that looked bad in every particular; in fact, the average man would not think it worth while to turn it over anywhere in a gold region, but when it was crushed and "horned" out, I saw a different feature in the case. By applying an eye-glass to the same, I found gold staring me in the face beyond the question of a doubt. I look upon this mountain as one containing wealth in gold almost beyond computation. I do not give the opinion as an expert, but as one who has a pair of eyes in his head and sees in an unprejudiced manner. On both sides of the mountain, silver leads are thick and miners with plenty of "sand in their craw" are hard at work developing the same. On the other side of the mountain, and nearer to Tombstone, other miners are at work developing the many leads they have discovered.—*St. Louis Journal of Commerce.*

PIPE-ORE LIMONITES.

We can not pass without notice, the beautiful hypothesis offered by Professor Lesley (p. 17, QQ, Second Geological Survey of Pennsylvania) to explain the genesis of the "pipe-ore limonites." These are not to be confounded with the "pipe-veins" of Derbyshire, for instance, which are merely tubular bodies of lead ore occurring in fissure-veins. The "pipes" of limonite are "singular steeples of botryoidal and radiated iron ore," which "rise from the solid ore at the bottom of some of our great mines to heights of fifty and even 100 feet, through deposits of ore-bearing clays which fill vast pots in the limestone country."

Professor Lesley says he has long held that these deposits are made in caverns, the roofs of which were subsequently carried away by erosion. But there was difficulty in accounting for the support of the vast roofs which the size of some of the deposits required. He now suggests that these roofs were supported by "stalagmite steeples, rising to meet stalactites pendent from above"—a phenomenon common in large limestone caves. "If such a cavern, with all its piers finished, were to have its outlet choked, and to be filled with water through which insensible currents moved, it would become filled with ferruginous clays, and in the end all its piers of calcite would be metasomatized into limonite of the variety known as pipe-ore." Subsequent erosion removing the roof would expose the clay as the country surface, and leave the metamorphosed stalagmites as pipes of ore standing in the clay and "descending with broadening bases to the floor." This explanation seems to us to fit the observed facts perfectly.—*Engineering and Mining Journal.*

With respect to the six days of creation corresponding to six geologic periods, let me repeat that no such six periods are known to geology. No geologist recognizes just six periods in creation. Lyell treats of four eras, thirteen formations and thirty-eight strata; Dana mentions seven ages of rock, five divisions, or ages, of geologic time (and very different, indeed, from the six days of Genesis), subdivided into twenty-three periods. Gray and Adams describe five classes, eight orders, and fourteen systems of rocks; Page's "Geology" has five classes and twelve systems; Steele's "Fourteen Weeks in Geology" has four eras or times, seven ages, and twenty-one periods; Figuier and Bristow have five epochs and thirteen periods; Denton has eight ages, or eras, and eleven periods; Taylor has three eras and nine periods; Dawson has four periods and sixteen minor periods; Gunning has ten great periods; Nicholson has three periods and thirteen systems or formations; and Newberry has four eras, seven ages, and twenty-two periods. Nowhere do we find a trace of any *six* geologic periods.
—*W. E. Coleman in Western Homestead.*

RAG SUGAR.

It is said that a German manufactory produces, per day, five hundred kilogrammes of glucose, taken from old linen rags. These rags, composed of fibers of almost pure cellulose, are first carefully washed, then treated with sulphuric acid (oil of vitrol) which converts them into dextrine. The dextrine so obtained is submitted to a wash of lime water, then treated with a new quantity of sulphuric acid, stronger than the preceding. Next the mass is transformed and crystallized into glucose, chemically identical with that which constitutes natural sugar, called grape sugar, the same which is found in honey and ripe fruits. With this glucoe they make, in a manner as fraudulent as it is economical, rich confections, gooseberry jelly and others, according to the choice of the consumer.—*Le Technologiste.*

PRESERVATION OF FOODS BY SALICYLIC ACID.

TRANSLATED BY MISS MAY FEE FROM "LE TECHNOLOGISTE."

The author has had in particular view, in the following, the household exigencies during the summer season—the time when we see all kinds of meat and fish rapidly spoiling. Who can calculate the amount of meat spoiled during an exceedingly warm day? Among the methods used to prevent and stop fermentation, ice and cold occupy a front rank; but neither of these is always at everybody's command.

With Salicylic Acid, it is easy to accomplish the purpose by two different methods: either by dipping the substances to be preserved into a solution of Salicylic Acid (three grammes to a litre of warm water); or better still, preparing a preserving salt by an intimate mixture of cooking salt pounded fine, in the proportion of fifty grammes to one gramme of salicylic acid. In order to preserve meat for eight or ten days, in summer, carefully rub all its surface with this mixture. At the moment of cooking wash the meat in a little fresh water. The salicylic acid will leave no taste or smell.

In a pavilion of the fish hall in London, there is a reservoir filled with a strong solution of salicylic acid, in which the merchants, for a small recompense. dip their fish to keep them perfectly fresh for a long time. Moreover, this practice has the great advantage of purifying the surrounding air. The antiseptic properties of salicylic acid have been happily utilized by the owners of cod-fish ships; its regular employment has saved whole cargoes of cod-fish from the decomposition which menace them during the warm weather. We shall also say a few words about the use of salicylic acid for maintaining, in a good state for consumption, the canned substances of all natures, after they have been opened.

CARE OF TREES AND SHRUBS.

In view of the drouth which prevailes in many parts of the country and its unusual severity over large districts, the *Rural New Yorker* suggests to those who have planted trees or shrubs the past spring that there is one method, and so far as we know, says the writer, only one by which they may be protected against injury or death from that cause. Surface watering has been shown to do more harm than good. The ground is made hard and compact, thus becoming a better conductor of heat while it becomes less pervious to air and moisture. A portion of the surface soil should be removed, and then pailful after pailful of water thrown in until the ground, to a depth of two feet and to a width about the stem of not less than three feet in diameter, has become saturated. Then as soon as the water has disappeared from the surface, the removed soil should be well pulverized and returned. A covering of boards, straw, or hay, or even of sand or gravel, may then be applied, and the tree or shrub, thus treated, will pass through ten days of additional drouth in safety.—*Scientific American.*

EDITORIAL NOTES.

IN our next number we shall have an article from the pen of Mr. C. A. Shaw, U. S. Signal Observer, at Madison, Wisconsin, on a Variable Scale for Barometric Pressures, presenting some original ideas based upon his experience as an observer.

Professor Oren Root, Jr., formerly Professor in the Missouri State University, recently Superintendent of the Public Schools at Carrollton, Mo., and now supplying the place of Rev. Dr. Kimball, at the Second Presbyterian Church in this city, has lately been appointed Professor of Mathematics at Hamilton College, New York. This is a very fitting appointment, though it is rare for an Eastern College to seek any portion of its Faculty in the West.

JULY was an unusually pleasant month, there having been but three days when the heat at 2 P. M. exceeded 90° in the shade, while there were none when the heat at 10 P. M. exceeded 81°, and very few where it exceeded 75°, The highest point reached by the mercury at 7 A. M., was on the 9th, when it marked 78°. The highest point reached in the middle of the day, was on the 13th, 96°, and the highest at 10 P. M. was on the same day, 81°, with pleasant breezes nearly every night. It showed the lowest average heat since July, 1876, when there was not a day whose maximum heat exceeded 90°, and only two above 88°.

Dr. John Fee, of this city, will hereafter regularly contribute to the REVIEW translations of popular articles from its German, French and Italian exchanges. This will be a decided advantage to our readers, not only from the freshness of the foreign matter thus furnished, but also from Dr. Fee's well known skill as a translator and transcriber of these languages.

SINCE our last issue we have made arrangements with Dr. E. A. Frimont of Ozuluama, Mexico, to correspond regularly with the REVIEW upon archæological, anthropological and other similar subjects. From what we know of him we anticipate very valuable and entertaining letters.

UNIVERSITY OF KANSAS,
LAWRENCE, KANSAS, July 26, 1880.

* * * * * * *

"ALLOW me to congratulate you upon the success of the REVIEW, both popularly and scientifically considered. It fills a gap in our scientific literature and is an essential to every lover of science in our new America.

"Very truly yours,

F. H. SNOW."

THE 29th meeting of the American Association for the Advancement of Science, will commence on Wednesday, August 25th, at the Massachusets Institute of Technology, in Boston, and the general sessions will be held in Huntington Hall. Lewis H. Morgan of Rochester, New York, is President. Prof. F. W. Putnam of Salem, Mass., is permanent Secretary. A very large attendance is expected and the meeting will undoubtedly be of the greatest interest.

THE office of the *Caterer* has been removed to 141 Queen Victoria St., London, C. E.

RECENTLY a well equipped expedition has been dispatched to Central America, charged with the work of systematically searching for everything that may tend to place within the domain of history the facts connected with a people whose career must have been one of the most interesting in the general development of the world's civilization. The founders of these cities were our precessors on this continent; their peculiar civilization and their æsthetic development are of the highest interest as regards the question of the origin of man himself; their history is, in fact, the first chapter of the general history of the American continent. Though we are not the lineal descendants of these builders of the cities that must have rivaled even Babylon and Nineveh in some of their architectural features, the results of their culture have been left to our safe keeping, and from these results it is evidently our duty, as far as possible, to gather the materials for filling up the unwritten first chapter of our history. A full account of the explorations of the party comprising the expedition is to be published from month to month in the *North American Review*, with illustrations of the most important objects discovered. The August number of the *Review* contains an article by the editor introductory to the series, entitled "Ruined Cities of Central America." Other articles in the same number of the *Review* are "The Law of Newspaper Libel," by John Proffatt; "The Census Laws," by Charles F. Johnson; "Nullity of the Emancipation Edict," by Richard H. Dana; "Principles of Taxation," by Prof. Simon Newcomb; "Prince Bismarck as a Friend of America and as a Statesman," by Moritz Busch; and "Recent Literature," by Charles T. Congdon.

MR. HENRY SHAW, whose name has been rendered illustrious in connection with the botanical horticultural history of St. Louis, by the establishment of the new world-famous Botanical Garden bearing his name, and of Tower Grove Park, which he so munificently donated to the city of St. Louis, celebrated on July 24th, the eightieth anniversary of his birthday.

Professor F. E. Nipher, of the Washington University, St. Louis, Mo., who has been spending part of his vacation in verifying his magnetic observations, writes: "Our results are wholly in accord with the work of the two years before, and show that the conducting power of the soil, is what determines the *larger* abnormal deviations of the magnetic needle. Before I leave it I mean to settle the matter so that it will be evident enough. We start this evening for another tour from Salem southward to the Arkansas line"

THE sixty first volume of *Harper's Magazine* began with the June Number. In the July Number was begun a new serial novel by HENRY JAMES, JR., entitled "Washington Suqare"—an American story of unusual interest. The September Number will contain the continuation of WILLIAM BLACK'S "White Wings;" the third part of "Washington Square," by HENRY JAMES, JR.; "The American Graces," a biographical sketch of the three Misses Caton of Baltimore—Elizabeth, Mary and Louisa, who married respectively Baron Stafford, the Marquis of Wellesley, and the Duke of Leeds—with beautiful portraits of each; the second part of W. H. BISHOP'S "Men and Fish in the Maine Islands," illustrated by BURNS; "The Family of George III.," with twenty-one portraits—fac-similes of old engravings from paintings by the best English artists of the latter part of the eighteenth and the first quarter of the nineteenth centuries; the third part of REBECCA HARDING DAVIS' "By-Paths in the Mountains," illustrated by GRAHAM; "The Seven Sleepers' Paradise Beside the Loire," an illustrated paper by M. D. CONWAY; a beautiful poem by WILLIAM M. BRIGGS, entitled "Amid the Grasses," illustrated by WILLIAM HAMILTON GIBSON; "Squatter Life in New York," by WILLIAM H. RIDEING, with characteristic illustrations by SHULTZ and KELLEY; and the usual variety of short stories, timely articles, etc.

The *American Bookseller*, which is itself an almost indispensable aid to librarians and other book buyers, commenced the publication on July 1st, 1880, of the *Monthly Index* to current periodical literature, proceedings of learned societies and government publications. It consists of the titles of the best articles in all the leading periodicals of the United States, whether scientific, professional or literary, and is well worth its price to the student in almost any branch of education who can not afford or has not the time to read all the current literature of the day. $1 per annum. 10, Spruce St., New York.

The *Industrial World and National Economist*, Vol. 1, No 1, presents itself as an advocate and gazetteer of Home industries, Commerce, Finance, Insurance, Railroads and Mining. It is published weekly at Montreal. $3 per annum.

The *American Naturalist* for August, says that Mr. J. Walter Fewkes, of Boston, has been engaged to deliver a course of lectures on natural history to the public schools of Newton, Mass., and handsomely endorses both the scheme and the teacher engaged.

A critic in the *Atlantic Monthly* speaks of Mr. S. S. Cox's Search for Winter Sun Beams as "depressing reading, from the fact that that the author seems to have labored continually under the feeling that it was incumbent upon him to be funny, and in obedience to this sense of duty he frequently indulges in jests by the side of which grinning through a horse collar is a serious and dignified occupation."

Science is a new illustrated weekly record of Scientific Progress, edited by John Michels, and published at 229 Broadway, New York. It is intended to be a medium for presenting immediate information of scientific events, and each department is to be under the supervision of a specialist in that department. The first number made its appearance July 3d, in quarto form, 12 pages, 10 cents per number.

We have received Nos. 126 and 127 of *Le Technologiste*, Louis Lockert, Rue Oberkampf, Paris. This is a weekly publication devoted to the application of science to the industrial arts. Its eminently useful and practical character can be readily understood from a summary of contents: Bleaching of Cotton in Skeins; On the Method of Stamping Gold and Silver Colors on Woven Goods; On Decorative Weaving; The Preservation of Foods by Salicylic Acid; The Adulteration of Tobacco; Defibrating of Sugar Cane; On Rag Sugar; A New Compound Cement for Pavements; The Coloring and Decorating of Porcelain and Chinaware. We cheerfully commend this journal to the manufacturers of the United States.

"L'Exploration." Revue Des Conquêtes de la Civilization Sur Tours les Points du Globe: M. Paul Tournafond, 35 Rue De-Grenelle, Paris. This handsome weekly of sixty pages, large octavo, is now before us. It is devoted to the collection and diffusion of geographical knowledge. Its editor assures us that it is the single tie that binds together the only sixty-five geographical societies that are scattered over the five great divisions of the globe. In the present number we observe a lengthy extract from Hall's second Arctic voyage, by James Jackson, a long and original letter from Soudan from the pen of Dr. Matteucci, who is now directing the Italian Scientific expedition to Central Africa. Shorter articles from various parts of the Globe, civilized and uncivilized, some necrological announcements and a new map of Cochin China complete the issue. We are happy to say that no one, who intends to be abreast of the latest geographical researches, can afford to be without *L'Exploration*.

Mr. Aldrich's "Stillwater Tragedy" in the *August Atlantic* grows in interest. Dr. Holmes in a characteristic poem, entitled "The Archbishop and Gil Blas," sings with a pathetic felicitousness of growing old. John Burroughs, one of the most charming of outdoor writers, contributes "Pepacton: A Summer Voyage down the Delaware." Mark Twain has a very pungent tale entitled "Edward Mills and George Benton," which satirizes keenly certain forms of pseudo-philanthropy. Mrs. Wallace, wife of General Lew. Wallace, Governor of New Mexico, writes "Among the Pueblos;" Richard Grant White's English article this time is "Taurus Centaurus." The political article discusses "The Republicans and their Candidate" whom it regards as wholly worthy of confidence and enthusiastic support. Col. Higginson and Susan Coolidge furnish poems; and reviews of new books and an attractive variety in the "Contributors' Club" complete a capital Summer number. The *Atlantic* for September will contain two important political papers: one on Candidates and Parties, and the other relating to the duties of independent voters at the present juncture; also, a brilliant society story by the author of "One too Many"; a study of the intimate life of a noble German family; a study of the people of a New England factory village; an article on women in social and charitable organizations; a paper on socialistic assassinations; and a full variety of essays, reviews and poems.

From the Catalogue of students at the University of Kansas for this year, we glean the following items: The number of students is 438—being an increase over last year of 38. Missouri sends seventeen, of whom six are from this city, viz.: Miss Ethel B. Allen, R. W. E. Twitchell, Wm. G. Raymond, Orais E. Smith, A. M. Finney and H. M. Lewers. Eighteen different states are represented. The prospects are good for 500 students next session.

Prof. E. T. Nelson of the Ohio Wesleyan University, in writing for back numbers of the first and second volumes of the Review, takes occasion to speak thus most flatteringly of it: "I feel it to be the *best* journal for the general student that is published in our country. It is for this reason that I wish to complete my set."

The *Popular Science Monthly* for July and August, reached us about the same time, the former too late for serviceable notice. The contents of the latter are varied and valuable, comprising articles on The Kearney Agitation in California, by Henry George, in which an attempt is made to show that "law" governs human actions as it does the conditions of the material universe, and that social phenomena may be attributed to general rather than special causes; the second chapter of Radeau's Interior of the Earth, translated from the *Revue des Deux Mondes:* The Method of Zadig, by Prof. T. H. Huxley, which is a very attractive account of the manner of scientists in the interpretation of fossil remains and the method of reasoning which enables them from a fragment of an extinct animal to prophesy, not only the character of the whole organism, but its past and future conditions; The Medicinal Leech; Recent Original Work at Harvard College; Geology and History; The Cinchona Forests of South America, and many others equally valuable. As usual, the Editor's Table and Literary Notes constitute a very attractive feature.

Our space is too limited to say more of *Good Company* for August, than that it continues to maintain a literary character which fully justifies it in assuming so self appreciative a title. It is a society magazine of just the kind to suit the best families all over the land.

The *American Antiquarian* for April, May and June, being No. 4, of Volume II, is decidedly the best number yet issued, and deserves an extensive sale. In our opinion, no magazine of its class, either in the United States or across the water, equals it. Rev. Stephen D. Peet, is editor, but he has as associates, Prof. E. A. Barber of Philadelphia, Prof. R. B. Anderson, Madison, Wis., A. S. Gatschet, Washington, D. C., and Rev. Selah Merrill, Andover, Mass.; while he has as contributors apparently nearly all of the archæologists of the country.

KANSAS CITY

Review of Science and Industry,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. SEPTEMBER, 1880. NO. 5.

GEOGRAPHY.

THE HOWGATE EXPEDITION.

The following extracts from the private journal kept by Dr. Rohé, surgeon of the Howgate Expedition, furnish a brief record of the voyage of the Gulnare from Washington to St. John's, N. F.:

Weighed anchor at 9:20 p. m., on June 21st, and reached Hampton Roads June 22d at 11:00 p. m. Steamed out of the Roads in the afternoon of the 24th and passed through the capes about 5:00 p. m. On the 25th there was considerable swell but the weather was pleasant. On the 26th hourly meteorological observations were begun by Mr. Sherman, Mr. Jewell and myself assisting, each taking a watch of eight hours.

June 27th was cool and pleasant. The ship behaves very well, both under steam and sail. About 9:00 p. m. it became very foggy, and at 11:00 p. m. the fog was so dense that objects could not be distinguished at a very short distance.

June 28th. A rather monotonous day. About half-past eight at night, however, the engineer startled the whole party by the announcement that two of the fire-boxes had collapsed, rendering the engine unserviceable. He made no explanation of the cause of the trouble. The accident is a great disappointment to all of us.

June 29th. The breeze was fresh and the weather cool, damp and foggy.

June 30th. The weather was pleasant. We are north of the latitude of Halifax, as the coast of Nova Scotia is in sight. Capt. Palmer thought it imprudent to make for Halifax harbor during the fog yesterday, and has determined to proceed directly to St. Johns.

July 1st. The weather was cool and foggy, and the wind fresh during the day.

July 2d. Nearly calm throughout the day.

July 3d. Brisk head wind and considerable swell.

July 4th. At 7:00 a. m. the temperature was 51°. The wind and sea-swell of yesterday continued during the day, at night it was very rough and stormy. Foggy at intervals yesterday and to-day.

July 5th. Heavy swell still continues. The vessel is making fair progress under sail, although the cargo is not properly trimmed, there being a decided list to port.

July 6th. Almost calm to-day. Sighted a number of small icebergs yesterday and to-day.

July 7th. At daylight Cape Spear, just south of the entrance to the harbor of St. Johns, N. F., was seen about five miles off, and soon after we signaled to a tug to take us into the harbor. At 9:00 a. m. dropped anchor opposite the Queen's wharf.

On the eighth day of July Mr. Sherman, Mr. Jewell and I began a series of observations on shore, with the magnetometer, dip-circle and pendulum.

During our three weeks stay in St. Johns the observations were continued every day except Sunday, and a good series of results obtained. Hon. John Delany, Postmaster General of the province of New Foundland, placed his well-appointed private observations entirely at the disposal of Mr. Sherman and rendered all the aid possible in order to make our work pleasant and satisfactory. For many personal favors, I am under obligations to him.

As soon as the vessel arrived, a board of survey inspected the damaged boiler, and steps were taken to have the damage repaired. I do not know what the official report of the board is, but I gathered from conversations with members of the board and other engineers, that the accident could only have resulted through the carelessness or incompetence of the engineers in charge of the vessel. The same impression is, I believe, current among the gentlemen composing the scientific party and the officers of the ship.

The engineers left the vessel at St. Johns and returned to the United States on the St. Alhambra of the Cromwell Line.

Of the present engineers, nothing but the best reports can be heard in St. Johns, where they are both well known. Mr. Stein, the chief, is a German and has a certificate of competence from the German government. He is also a practical machinist, and the business-like manner in which he attends to his work inspires every one with confidence in his ability and prudence. The assistant, Mr. McRobbie, appears to be equally proficient in the practical work of his department. Both of these gentlemen have been in charge of the engines of steamers plying along the northern coast either in the seal fishery or in the Labrador coast trade. They are, therefore, thoroughly familiar with the management of a steam engine in the midst of the ice. They may, I think, both be relied on to do their duty as well as it can be done.

So far as I am able to judge, Capt. Palmer and his first officer, Mr. Bailey, are thorough seamen, whose prudence will take the ship wherever it can be done with safety.

In conclusion, permit me to state that my confidence in the sea-going qualities and entire safety of the "Gulnare" is not in the slightest degree impaired by the accident which has, it appears, caused no little uneasiness among the friends of those on board.

ACCIDENT TO THE GULNARE.

The following report of the Board of Survey upon the Gulnare on her arrival at St. Johns, gives officially the nature and cause of the accident to her boilers referred to by Dr. Rohé.

REPORT OF THE BOARD OF SURVEY.

We, George A. Pitts, mechanical engineer, associate of Kings College London, and member of the Institute of Mechanical Engineers of Great Britain; Robert Stein and Alexander Murray, sea-going Engineers-in-Chief, having been called upon by T. N. Malloy Esq., American consul in this port, and Captain Palmer, master of the S. S. Gulnare, to survey the boiler of said steamer, do declare that we have made a careful examination of the said boiler, and found the crowns of the three furnaces collapsed, and we consider the accident was due to carelessness. We base our opinion on the fact that during our examination we found deposits of salt on the crown of the furnaces to a thickness of about ⅝ inch. Further, the crown of the combustion chamber is in a good condition. We also certify that the damage done to said boiler can be repaired in St. Johns, and the boiler placed in good and efficient condition to enable the steamer to prosecute her present or any voyage. We also suggest that a stop-valve be placed on the boiler to supplement the ordinary butter-fly valve at present in use on the engine.

St. Johns, Newfoundland, July 7th, 1880.

(Signed) George A. Pitts.
(Signed) R. Stein.
(Signed) A. Murray.

THE GULNARE AGAIN AT SEA.

The Gulnare left St. Johns July 30th, for Lady Franklin Bay, which locality it was proposed to attempt reaching without stopping at Disco, as originally contemplated.

THE CRUISE OF THE CORWIN.

The official report of Captain Hooper, commanding the revenue steamer Corwin, now in the Arctic in search of the missing whale vessels and under orders to communicate with the Jeannette, was received at the treasury department August 6th. The report is dated Norton Sound, June 19th. Captain Hooper says:—

We left Ounalaska on the 8th inst. and visited St. George and St. Paul's on the 9th inst. After communicating with the special agents on these islands and taking on board a quantity of pup seal skins for Arctic clothing for the officers and crew and putting the ice breaker in place we proceeded north the same evening.

On the 11th we encountered ice a few miles north of Nounivak Island, in latitude 60 deg. 45 min. north, longitude 167 deg. 50 min. west. A fresh southwest gale was blowing at the time, so we did not enter the ice until it moderated on the 13th inst., after which we worked our way along to the northward, taking advantage of every opening or lead which showed itself. We worked along in this way, sometimes making a few miles a day and at others drifting helplessly in the pack until the 17th inst., when a sharp northeast gale broke up and opened the ice and started it off shore, allowing us to proceed on our way the following day. We arrived here this afternoon and found the sound filled with ice. We are now at anchor sixteen miles from St. Michael's. We shall endeavor to get a boat ashore to reach there overland to-morrow and deliver the mail which we have on board for that place, and continue northward as fast as the ice will permit.

All hands are in good health and everything satisfactory. The Corwin has proved herself a very able vessel. Although forced through heavy ice for nearly a week, and at times lifted bodily up by the pack she seems none the worse for it. I hope to be in Kotzebue Sound ahead of the whisky traders and break up their illicit trade for the summer. I shall endeavor to get some tidings from the missing whalers from the natives in Kotzebue Sound, and also from those on the Asiatic side, either in Plover Bay or in the vicinity of East Cape, whichever the ice will permit us to visit first.

While in the ice, off Romanzoff, some natives visited the vessel and reported the past winter as the most severe ever known, and some sealers from Norton Sound, who have just come on board, confirm the report. They say the ice in the sound only broke up yesterday.

A day later than the report Captain Hooper wrote to Major Clarke, chief of the Revenue Marine service, giving an account of the hardships already experienced on the voyage northward. In this letter he says:—

This will be the last chance to report, I suppose, until we return to San Francisco. We had a hard passage through the ice. We entered it on the 13th, after trying in vain to get around it, and were six days getting here. The first day we only made about forty miles, and the second day about twenty. The third and fourth days we did not make any distance at all and had as much as we could do to save the vessel. The ice set us in off the lower mouth of the Youkon in five fathoms of water. At this depth about half the ice was aground and the floating ice was carried by it by the current at least three knots an hour. The crashing and warring of the ice on all sides as the drift ice struck that aground was demoralizing to weak nerves. Of course we were carried along with it and several times were caught in the "nip."

Our engines had no more effect on the vessel than a toy engine would have had. We came near losing our rudder, and at times our boats were in danger, the ice was so high. The screw steering gear was carried away and the wheel chains parted. After realizing the effect of a "nip" I saw the necessity of having the rudder so it could be unshipped at short notice. So I went to work, fitted a piece of oak plank over the rudder head so that it could not unship itself, but can be removed readily if necessary, cut a piece out of the apron the size of the rudder casing and cleared the rudder head of the patent steering gear and everything that would not go down through the cashing, made a band and put in to keep it from cracking, rigged a pair of shears over the stern and made a purchase, then put all hands at work and carried coal in sacks forward until her stern was raised out of water sufficiently to get at the woodlock and split it out. We can now unship the rudder and land it on deck in three minutes, and after a little practice can do it in two. I think I have no fears of losing it now.

This is tough business on revenue cutters, I can assure you. If we had not forced her through the ice we would not have been able to get far along for three weeks yet. I thought it was all up with her on the morning of the 18th. We had been at anchor close in under the Cape Romanzoff during a northeast gale and snow storm nearly all day of the 17th, and on the 18th it backed to northwest right on shore and blew harder yet. The ice had been broken and started off shore by the northwest wind, and, of course, as soon as the wind changed it came back. We got under way and tried to work out into the pack to keep from going ashore, but for a while it showed such a solid front that we could not penetrate it The ice kept driving us in shore until we had only two and three-quarter fathoms of water, when an opening showed itself and we shot into it and succeeded in getting fast to a piece that was aground in five and a half fathoms and rode comfortably until the gale broke and the ice started off shore again. The piece we made fast to probably covered a surface of four acres, drew thirty-three feet of water and was about twenty-five feet high above the water, so you can form an idea of what the Behring Sea ice is like. Our pilot says he never saw anything like it outside of the Arctic.

A native has just arrived from the shore with a note from the Alaska Commercial Company, who reports the winter as having been terrible—very cold, with an unusual amount of snow and heavy storms. None of the traders have arrived from up the river yet. The wild geese, which usually have their young hatched out by this time, have just commenced to arrive and lay their eggs. We will start north to-morrow, or perhaps this evening if the ice shows a break. I don't expect to get further than Kotzebue Sound for a month. We won't spare her, but will push on as fast as possible. I have no fears but we can go as far as any one. The Corwin has good power and is very strong.

IS THERE AN OPEN POLAR SEA?

CONCLUSIONS AGAINST THE POPULAR THEORY DRAWN FROM THE RESULTS OF MANY BOLD AND ENERGETIC EXPLORATIONS.

Dr. I. I. Hayes, the Arctic Explorer, in a recent letter to the New York *Herald*, expressed his well known views in reference to the existence of an open polar sea; to which a Springfield, Mass., correspondent takes exception as follows:—

In Dr. Hayes' letter on the prospects of the Jeannette there is one paragraph which is of so much importance in view of the history of opinion in regard to the open polar sea, that I wish to advance some considerations weighing against the opinion there expressed, in the hope that Dr. Hayes may see fit to publish his views more at length in the *Herald*.

In speaking of the intention of Captain DeLong he says:—"Of course no one imagines that there can be any such thing as a sea about the Pole wholly free from ice, but it is equally inconceivable that so large a body of water, embracing an area of more than three millions of square miles, could be at any time firmly and completely frozen over." And he infers that should captain DeLong reach the northern termination of Wrangell Land he would encounter large areas of open navigable water. The opinion here expressed by Dr. Hayes that there is in the extreme north a virtually open sea, is the same as he advances at the close of his account of his attempt to reach the open polar sea in 1860—61; and the argument is also the same—viz: that within the encircling shores of the northern continents, that is, roughly, within the parallel of eighty degrees north latitude, there is a vast expanse of sea where the ice cannot fasten itself to the land and will therefore of necessity be broken to pieces by wave action. Now, if it were an ascertained fact that there is this vast polar water, this conclusion might seem to be necessary; but what support is there to the opinion that we have this great unbroken expanse of water at all?

The progress of northern exploration, great as it has been, has never yet advanced beyond the boundaries of land. Parry, to be sure, in his remarkable attempt to reach the Pole from Spitzbergen, penetrated to 82° 45′ without finding land, but his journey proves nothing as to its existence or absence within a comparatively small distance of his furthest point, for traveling on the ice, he could not possibly have distinguished a low Arctic coast at a few miles distance. The memorable experience of the Austrian expedition of 1872 is well known. After drifting north of Nova Zembla for months, fast in the ice, over an unknown sea, they came at last (about latitude 79°) on a new land, which was traced by Payer above 82°, and the extreme vision of the Austrians was bounded on the north not by water, but by land, whose nothern limit and dimensions no one knows. Again, it is well known that Arctic explorers of experience find in the reports of the English expedition of 1875—76 reason for belief in the existence of land beyond the eighty-fourth parallel. The tremendous character of ice of the so-called palæocrystic sea, and the great hummocks which baffled Markham's sledge party, together with shallowness of the sea at the extreme point reached by Markham, are regarded as very strong proofs of the existence of land very much further north than any yet known. It is to this land to which Howgate's colony scheme looks in large measure for success, since it may offer a coast line trending north and reaching to or near the Pole. No one also yet knows the extreme northerly extent of Greenland and adjacent lands. The extreme vision of the English saw only the west Greenland coast losing itself in the mystery of the Arctic snows and ice north of 83°. And finally DeLong's expedition itself is proof of land in the extreme north in yet another quarter than those named. That Wrangell Land exists north of Siberia is known. How great it may be and how far north, no one knows. Dr. Hayes himself admits it may reach to the Pole.

It then remains true that whithersoever men have gone in the far north they have found not sea only, but land also. It seems a fair deduction from the past history of exploration that wherever they may hereafter go, there they will still find land. If, now, this is so, until we know accurately the amount and disposition of these Arctic lands all conjectures based on their presence or absence must be idle. Suppose these lands to be grouped anywhere about the course of the Jeannette, will we not have then just the conditions of coasts approaching one another sufficiently near to allow the ice to form and accumulate and pile itself up in the enormous masses of Nares' palæocrystic sea or of those whose tumult seemed pandemonium let loose around the Tegethoff, while her navigators were yet, as they supposed, in the midst of a boundless sea?

In the introductory chapters of his book, Payer, reviewing the history of Arctic explorations through three centuries, remarks on the doctrine of the open polar sea and demonstrates, it seems to me, the groundlessness of that opinion by showing how, as men have approached, as they supposed, the northern boundary of that ice belt which they believed to girdle the open sea, that boundary has ever receded and the ice has ever grown heavier, the climate more severe, the nearer they have drawn to the Pole. If, then, there is virtue in the consistency of reasoning we must assume that beyond where man has reached, the same law holds true—that the further north we go, the thicker the ice becomes and the severer the climate. Any other conclusion is contrary to the known facts, and the belief in the open polar sea would seem to be born solely of splendid enthusiasms, high courage and desire to pierce the fascinating mystery of the far north.

D. W. B.

GEOGRAPHICAL SOCIETY OF FRANCE.

(FROM "L'EXPLORATION.")

Sitting of July 18th.—M. A. Grandidier in the chair. Meeting opened at eight o'clock. After reading of the official minutes, the president signaled the attendance of M. Pinard, the young explorer from Arizona, who will return to his explorations as soon as the state of his vision, considerably weakened, will permit—also the presence of Dr. F. M. Moreno, director of the Anthropological and Archæological Museum, at Buenos Ayres. This learned South American, continued the *resume* of his explorations, in the as yet scarcely known country of Patagonia, as follows: In 1873 I made my first voyage to Patagonia, in order to dig into the Indian burying grounds along the Rio Negro. After two months of excursions, I returned with forty-two skulls and some hundreds of stone implements. In 1874, I returned to the Rio Negro. My excavations gave me eighty crania, some incomplete skeletons and three hundred stone objects. From the Rio Negro, I passed to the Rio Santa Cruz; in order to ascend it, but some obstacles preventing me, I was only able to make some ethnological collections, in the environs of the sea.—In 1875, I left overland, from Buenos Ayres, for the purpose of passing over Patagonia until I reached Chili.—Arriving at the Rio Colorado, I continued my anthropological researches, and at the Rio Negro, for the third time, I was able to augment my collection of skulls. Leaving this place, with a domestic and five Indians, I followed the banks of the river and arrived on the slope of the Andes. There the Araucaniens or *Manpuches* impeded the continuance of my voyage. Condemned by a council of war, I obtained permission to visit lake *Nahuel-Napi.* After some weeks of hunting, of religious feasts and orgies, I was given leave to return to Buenos Ayres, where I arrived after having had a battle with some Indian cattle thieves. I left immediately for the northern part of the Argentine Republic, with the object of excavating the ancient forts and cities of the *Colchuguis.* In October, I left for the fourth time, for the purpose of traversing Patagonia. After making some collections at Chuburt and Port-Dèsirē, I commenced the exploration of the Rio Santa Cruz. There, with my canoe, I penetrated as far as the lake from which it takes its origin. I could see two other lakes to the north, alive with Indians, also a volcano in activity, which I baptized with the name of Fitz-Roy. I reached afterward, by land, the strait of Magellan and returned to Buenos Ayres. On my return, I donated all my collections, anthropological, zoölogical and palæontological, to the government which has established the museum of which I am the conservator. To augment this collection, I left in October, 1879, for a voyage of two years in Patagonia. After ascending the Rio Negro, in my little steamer, 400 kilometers, I directed myself to the South, on horse-back, to the distance of 100 kilometers, thence to the west-south west, traversing a region as yet unexplored. In the place of plains and table-lands, I saw mountains from 1000 to 2000 meters in height. Here I discovered some ancient volcanoes, and some basaltic grottoes, which had served as human habitations; also some human skulls. Arriving at 43° 30′ south, at the foot of the Andes, I found some Indians, and some days afterward, I continued my course to the North. I explored the banks of the lake *Nahuel-Napi*, where I found some grottoes containing bones. Here, at the western part of the lake, some Araucanien Indians took me prisoner—brought into the presence of the principal chief, whom I had known in my voyage of 1875, I was passed to a council of war, and after three days of feasting, I was condemned to death.—"God was angry, and the heart of a Christian must be sacrificed to Him." Two days afterward, I escaped in the night, with my domestic and interpreter. We constructed a raft, and after two nights and seven days of travel, through the rapids, we reached the Argentine encampment. My companions, whom I had left in a hospitable Patagonian village, informed by a friendly Indian, had saved my anthropologieal collection and my botanical gatherings—I was able to save on my person a part of my journal and some astronomical observations made at twelve different places. Arrived at Buenos Ayres, I was sent, on recommendation of physicians, to Europe. * * * * Session closed at 10.30.

J. F.

THE KHEDIVE'S GEOGRAPHICAL SOCIETY.

(FROM L'EXPLORATION.)

The session of June 11th was well attended, considering the terribly hot weather. It was devoted, as announced by the order of the day, to a conference with Dr. Zucchinetti, who left Cairo in the month of January, to make an excursion to the provinces of Bahar-el-Gazar and Bahar-el-Arab, thence to a part of Darfur, and of Kordofan, and also to that region of Nubia situated to the south of Obeida, a country as yet scarcely known.

He commenced his discourse by exposing the vast project he had conceived of traversing Africa as far as its southern extremity, for the purpose of studying it from a statistical and scientific standpoint, and for placing it in condition to contribute to that grand activity, in which intelligent Europe desires to place this part of the globe, heretofore so much neglected.

He then traced briefly, the line followed from Cairo to Khartoom, skirting the Nile, from Khartoom to Chiri along the White Nile as far as the third degree of latitude, where he was stopped by unexpected difficulties; also sketched the route of his return from Chiri to Gaba-Sciambia, thence to the West, to the Macracas, the Niam-Niams, the Gouro-Gouras on the Bahar-el-Arab, to Sciacca, to Fasher, to Obeida in Nubia, to Khartoom, to Djeddah and to Suez.

He interrupted the recital by quoting some notes, made in the course of his voyage, which excited the most lively interest. The Doctor spoke lengthily of Khartoom, Lake Noo and of the Leds (falls) which arrest the navigation of the river, and of the way to avoid them. He then gave a description of the Egyptian military posts and their organization. Gen. Stone, who was occupying the presidents' chair with Mr. Bonola, then took the floor to announce that among the new members of the Society were counted the engineers Lafitte and Bangabe. He also stated that the Society had recently established relations and exchanges with the Geographical Society of New York, with the Typographic Society of Geneva, and with the journal *L'Exploration* at Paris. He pointed out the favor with which the publications of the Society had been received abroad, and cited as an example the Bulletin of the London Geographical Society, which had reproduced with praise, some articles from the Bulletin of the Khedival Society. He proposed the name of Rev. Mr. Wilson, for honorary membership, who had but a short time before returned from the land of King M'tesa.

Doctor Zucchinetti then resumed his narrative. He expatiated on the customs of the savage tribes, on the *fauna* and *flora* of the countries he had explored, and on the resources which this country could offer to European activity. He continued with the details of his voyage to Darfur, Kordofan, and to Nubia. This last country is rich in gold; and he indicated the manner in which the natives gather the precious metal. Finally, he exposed his views on the measures he judged most opportune for ameliorating these countries, both morally and materially; and after having defined the character of the negroes, he closed with the opinion, that penetrating the country with roads and colonies would be the most powerful means of initiating civilization. The ideas of the speaker gave place to interesting discussions, and were judged, on the declaration of competent men, like Gen. Stone, Purdi Pacha, Col. Saddek Bey, and Dr. Rossi Bey, to be worthy of a profound examination. J. F.

THE POSITION OF THE CROZET ISLANDS.

The admiralty have received from Captain J. N. East, R. N., of H. M. S. Comus, a report of his visit to the Crozet Islands, early in March, in order to ascertain if any shipwrecked people were there, and to endeavor to establish a depot of provisions. No trace of any shipwrecked crew was discovered, but the stores of provisions and shelter-huts were successfully landed. The most important information which Captain East communicates with regard to this group is, that Hog Island should be placed thirteen miles north and west of its present position on the admiralty chart. The position of the other islands with regard to it appears to be laid down with tolerable accuracy, excepting that East Island is not more than seven miles distant from the southeast point of Possession Island. The Heroine breakers are reported to consist of one breaker very similar to the Bellows off the cape, and to be only one and a half miles to the eastward of a straight line drawn from the south end of Hog Island to Penguin Island, and nearer the former island.

MURDERED EXPLORERS.

A telegram from Zanzibar states that Mr. F. Falkner Carter and Mr. Cadenhead, of the Royal Belgian Exploring Expidition, have been murdered by Chief Urambo in Central Africa. Chief Urambo is believed to be the celebrated robber chief, Mercambo.

EXPLORATION OF PATAGONIA.

Don Ramon Lista has lately returned to Buenos Ayres after a further journey in Patagonia, in the course of which he has examined in detail the whole of the coast region between Bahia Rosas and Punta Villarino. From the outset he was unable to find any water, notwithstanding that careful search was made in all directions, and the expedition would have been compelled to retrace its steps had it not been for the opportune arrival off the coast of a small vessel with supplies. The region explored is reported to be extremely sterile; and the soil, which is burned up by a tropical sun, is mostly covered with prickly and stunted plants.

Carl Petersen, the warm-hearted and faithful assistant to so many Arctic expeditions, in which he served chiefly as interpreter, died at Copenhagen, on the 24th of June, at the age of sixty-seven years. He was with Penny, driving his dog-sledge, in 1850–'51, when Penny wintered in Assistance Bay with the two brigs (Lady Franklin and Sophia) and explored part of Wellington Channel. Next he was with Kane in Smith Sound, then with McClintock in the Fox, and lastly on a voyage with Torell and Nordenskiöld, to Spitzbergen, in 1861. He was a fine old fellow, resolute and warm-hearted. Sir Allen Young introduced him to the Prince of Wales the last time he was at Copenhagen. Petersen had charge of a lighthouse until 1875, when he retired, owing to failing sight, on a pension of 600 kronen. The English government had recently granted him a pension of £12 a year, and last year a number of Arctic friends in this country subscribed together and presented him with a small sum. These acts of kindness were deeply felt by the grateful old man, but he lived only a short time to enjoy the increased comfort they afforded him. He lived with his sister, whose husband kept a restaurant at Copenhagen. In early life he was long stationed at Upernavik, and married there. He leaves a son, who is a surveyor, and a daughter who married well.

METEOROLOGY.

PROPHECY OF THE WEATHER.

BY ISAAC P. NOYES, WASHINGTON, D. C.

The weather has ever been a favorite theme for the prophets, and most miserably have they failed. All are familiar with the prophecies or statements of our almanac makers. For years they have pretended to foretell the weather for months in advance.

The statements of the old almanac makers though "gospel truth" to the many, were not regarded as wisdom by the few who were more advanced in intellectual culture, yet even those of the highest culture could simply say "they did not believe;" no positive evidence had yet developed by which they could successfully controvert what their intellects could not accept. They must await future developments and see what they would bring forth.

In 1870 they brought forth the United States Signal service, whereby we were no longer confined to the accumulation of a few isolated facts gathered by men having no facilities for immediate communication with each other, or any means of conveying intelligence to one central head where it could be digested and made to serve the world as kindred facts in other departments have done.

It was not even possible for the Signal service to grasp the full idea at once; time was needed to advance the practical work necessary for so great an undertaking, and as facts were accumulated, they suggested new fields for the intellect to revel in, until now we have a very complete system, though not perfect as yet, for time is still necessary to complete and to suggest other steps in the line of this advancing science.

The weather map has proved beyond controversy that the area of low barometer is the center and motive power of the storm, and that this area of low barometer travels, as heretofore stated, in an easterly direction, and that back of this power of low barometer, lies the generating heat force of the sun, the creator of this power. The sun is our great physical first cause in this as in other things connected with and essential to our well-being on this earth.

The negative part of the weather system is the area of high barometer, which plays quite as important a part in the weather of our globe as the area of low barometer itself. The details and influence of high barometer will be deferred for some future paper, simply remarking here that it is an important power and is ever on the move and in the same general direction as the area of low barometer, and that we can not have the one without the other—that the area of high barometer is as essential and natural in the lighter body air as the hill or mountain in the physical contour of our earth.

It is not pleasant to controvert such a venerable notion as that the moon affects the weather and that by studying its various "quarters" and conditions, we may be able to prophesy the weather months in advance. The moon, it must be remembered, is continually on the move and ever progressing with the earth and the while moving around it. It therefore must necessarily, and does in turn, shine on all parts of the earth. Wherever the sun shines the moon shines also. The sun being a powerful heating body, generates the conditions we term low barometer. The moon, being a mere reflector of light, has no such power—at least its heat power is infinitesimal, and therefore has no power to produce or affect the area of low barometer. But it is often claimed that it has power over the clouds to collect or disperse them, as the case may be. On the same night with the same moon, new, first quarter, half, full, last quarter or old, the same moon is shining over territories where there is all sorts of weather from hot to cold, and from clear, cloudless skies to extents of territory covered with the most dense snow or rain-producing clouds. In one place it may be clear, bright moonlight, in another not a ray of light to be seen even with a full moon. Then these places may be and are distributed over the earth at intervals of from 500 to 1,000 miles, and sometimes more. This being the actual condition of things, it seems most absurd to claim or believe at this day that the moon at all affects our weather, or that it may be relied upon as a basis on which to found prophecies of the weather. When the new moon is upright so that its two ends or horns are level with each other, it is claimed that throughout this moon, we will have little or no rain, because the moon holds its water. Then when the crescent tips a little, one side being higher than the other, according to the universal idea, we will have plenty of rain during that moon. As though the rain which waters our earth, must be held in this little basin up in the sky. It must be remembered that the moon is 240,000 miles away from our earth, and at the best calculation our atmosphere is not more than forty-five miles high, and more than this that the clouds from whence comes our rain, are not over two or three miles high, and often much less, probably less even than a mile high. Our rain comes from the clouds that are temporarily suspended in the air generated through the heat force of the sun from the waters of the earth.

The sun is ever forming these clouds. The power of the moon in this particular is not worth considering even for a moment—might as well claim that the moon causes plants to grow, and is an agent for the generation and maintenance of life on this globe. As it rotates about the earth it happens that it goes through certain phases which western new moon, quarter, full, etc., and that at times the horns of the new moon will be level with each other and at other times not—all depending, as any one familiar with astronomy will know, on the relative positions of the sun, earth and moon. The sun will always shine on that side of the moon that faces the sun. This is a most natural effect and needs no proof. Relatively to the earth the moon must change, for the simple reason that these three bodies are ever changing their relation to each other, and this readily accounts for the different appearances of what we call the "new moon." The light of the sun shining on it, relatively to us, underneath, at other times a little to one side. That these merely accidental changes of the moon that have no significance as a motive power, positive or negative, that they should be a power to affect the conditions that produce or prevent rain that comes, and can only come by the generating force or heat of the sun, is most absurd, or that it should have any power over the motion of the clouds which are concentrated or dispersed only by that power generated by the sun which we term "low barometer." The prophecy of the weather based upon any such ideas as that the moon has any influence in producing such results, is most absurd and can not be maintained by facts or the least show of reason. We may have evenings where the sky over our particular locality becomes clouded when the moon is visible, or it may be cloudy and after awhile the clouds pass away, but not through any agency of the moon. If the moon had any such power as this, it would produce the same results every time, but we see that it does not, but rather with all sorts of moons we have all sorts of weather and changes which may readily be traced to a far more reasonable cause—that of the relative conditions of low and high barometer as effected by the great source of heat and light—the sun.

Another source of prophecy of the weather, is something which belongs rather to a season than to any extended time of years—a sort of sub-prophecy depending upon a prophecy of cold winter and warm summer, especially at the poles, is that of cold in summer developed from melting icebergs as they float down from the Arctic seas. This summer of 1880 there are a remarkable number of these icebergs. So the iceberg prophets are prophesying cold weather, especially off the Atlantic coasts.

When it becomes better understood that the heat of certain localities depends upon the concentrated power of the sun, making what we term the area of low barometer, and that this concentration is ever on the move, sometimes on a lower line of latitude the whole year through—when this beautiful law of nature is understood, it will be seen that the melting or non-melting of icebergs out in the Atlantic ocean, will have little or no effect upon our temperature, not one-tenth part as much as the melting of the ice in our ice-carts as they pass along the streets, or the melting of the ice in the refrigerators and water coolers of our houses.

Although the sun shines more directly over the equator than over the poles, and it is therefore warmer at the equator than at the poles, still the heat of the sun is not wholly concentrated there, and it is oftentimes warmer in the temperate zones than in the tropics, as discussed in a former paper, "Evidence From the Weather Map of 1879."

The melting of icebergs cools the immediate surrounding water and atmosphere, but its influence, like the melting of the ice in our ice houses, ice carts, refrigerators, or water coolers, is purely local.

In this connection the idea suggests itself that we make a better study of icebergs than we have heretofore done, and that one or more of our idle navy vessels be authorized to follow them, keeping as near them as safety will permit, and study them day by day and trace them up until the largest 'berg disappears under the heat of southern latitudes.

Then there is another, though fortunately a smaller class, who make some pretensions to scientific wisdom who have notions that the weather of our planet must be more or less affected by the relative position of our earth and her sister planets in the universe. For this year, these prophets have predicted all sorts of commotions in the elements because some four of the principal planets of our system come together nearer to the sun than for some eighteen hundred years or more. Indeed they are already out with their extravagant claims that (up to July) we have already had the fulfillment of the prophecy.

Now, the weather of this year has not been remarkable for its peculiarity thus far. We have had some severe storms, but what season do we not have them? They occur more or less frequently every year. This year, thus far, (July,) has not been greatly different from the average year. But when this class of prophets have prophesied, like Jonah, they want their prophecies fulfilled even though it bring great distress upon the nations. They do not like the mortification of being false prophets, or to see their scientific pretensions laughed at by the world.

Probably the most remarkable sensation as a weather prophet at present, is Mr. Henry G. Vennor, of Montreal. The name of this gentleman has been very conspicuous in the papers the past season as a weather prophet. Many people have faith in him and verily believe that he is reliable, and are willing to swear by him and contend that he predicted this and that storm, or spell of hot or cold weather.

When men claim to be prophets we want them to come out with plain and unequivocal statements. We want no "if" or "and," or general statements of uncertain sound, but the plain statement in black and white, just what will and will not occur.

According to the St. Louis *Republican*, in a letter dated Montreal, May 18, 1880, he says: "I believe that June will be an intensely hot month, and probably the first of June will be fall-like, with frost again. July will be a terrible month for storms, with terms of intense heat, but another fall-like relapse with frosts, will, in all likehood, occur a few days before the twentieth. I fear the storms of thunder and hail will be of unusual severity during July. I must claim the verification of my prediction relative to a cold wave, with frosts, over a large portion of the United States between the 10th and 15th of May. The relapse toward the close of the present month (May) will be more severe than that just past."

This is probably a fair sample of Mr. Vennor's predictions. We see that they are very general and non-committal as to exact dates and localities.

Mr. Vennor's first statement in this short article is that "June will be an intensely hot month" Where will it be hot—in Canada, or North or South of Mason and Dixon's line? It might be very hot in Pennsylvania or even in New York state, and yet very cold in Montreal. Over what territory must it be hot or cold to fulfill Mr. Vennor's predictions—in the Atlantic states, out West, or at the North or South? He claims the verification of predictions relative to a cold wave over the United States between the 10th and 15th of May.

As to the month of Juue, it was not unlike June weather in general, unless perhaps a little colder, as a whole. In the vicinity of Washington it was rather a cool month, though we had a few very hot days, still not as hot on a whole for the season as was the month of May. The greater part of May in this vicinity was very hot and oppressive, and that too for a very good reason—and it is never hot or cold relatively to the season, without this good reason.

May 10th and 11th it was very warm here. On the 11th, about 4.30 P. M. we (in Washington) had a summer shower with thunder and lightning, which lasted about an hour and then became cooler, as it generally does, though not always after such a storm. From the 12th to the 18th of May it was cool and pleasant, very seasonable weather for the time of the year. On the 14th of May it might have been intensely cold throughout the United States, East of the Mississippi but for a rather unusual relative location of the area of high barometer. On the 14th of May *Low* was on a line with the south-end of Florida, while *High* was to the north of Washington, thereby preventing Mr. Vennor's prediction falling true in force, or at least ameliorating it much. The latter part of May was extremely hot notwithstanding Mr. V's. prediction that we then would have a severe relapse.

July, Mr. Vennor says, will be intensely hot with terrible storms with another fall-like relapse. Now we all know that July is very apt to be hot and therefore to be accompanied with severe storms, and it is not an unusual occurrence to have a cold spell or two during the summer and that we are as liable to have it in July as in June or August.

In all these statements Mr. Vennor is no nearer, and gets as far from the mark as any other man who will study the Smithsonian or other reliable reports of the weather of the United States from year to year and venture a guess in accordance therewith. Fortunately for such prophets, the people, and even the people of high mental rank, are still quite ignorant of this weather question. It is a new subject. Many may disbelieve but at the same time they are unable to refute, so are very charitable to pretensions of this kind, coming from what they think or regard as commendable authority.

These changes of weather which Mr. Vennor speaks of never occur without a good and sufficient cause—a cause that may readily be understood by any intelligent person who will simply read the weather map—for it is there daily recorded in legible characters that never deceive. For example, it cannot possibly be hot in the nothern part of the United States or Canada, unless there is an area of low-barometer in that locality. It cannot be cold throughout the United States unless the area of low-barometer is on a low line of latitude. There is an endless variety of changes which the movements of low and high-barometer may make—more endless than the strains that could be played upon the "harp of a thousand strings." Sometimes by the peculiar location of the area of low barometer it may be warmer in the extreme north-eastern part of the United States, than in Virginia. For example, let the area of low-barometer be located off on the Atlantic Ocean and in the immediate vicinity of Calais, Me., as it was some two or three years ago this spring. Being on a high line of latitude, it caused the warm winds from the South to concentrate there, while it being so far to the East of Washington, and reaching down into the ocean, caused a severe West wind slightly to the North of West which made Washington one of, if not the coldest (recorded) place in the United States and much colder than Calais, Me., notwithstanding the fact of lower latitude.

Now when a cause is so well known, how much better would it be for these weather-prophets to say, that on such a date of such a month the area of low-barometer will be in such and such a locality—then those who know what ought to follow—what would be the result of such a location of *Low*, will know just what to expect. We will know whether it is to be cold or hot, in New England and the North-east generally or in Kansas and Missouri and the North-west. If these prophets will only tell us where *low* will be they will far surpass their present prophecies and the world, at least the intelligent world, will truly wonder at their knowledge of the works and ways of the great mysteries of nature. But until they can do this they had better not attempt any more of their present "prophecies," which are merely guesses which may be equaled by any number of persons who will study well the compiled weather reports of the past years and venture guesses in accordance therewith. Prophets should be men of superior and not inferior knowledge in the department in which they propose to prophesy. For such a course will only make them contemptible in the eyes of the world, when it comes to fully understand the cause that effects these matters.

In reading these comments on the prophecy of the weather, it may be asked if there is any method by which we may know or prophesy the weather for any great period in advance. For one I do not believe there is any such method, for the reason that these changes depend, as repeated over and over again in these papers, that all depends upon the location of low and high-barometer and that these relations are ever changing, and the changes seem to be an endless surprise that cannot, so far as we know at present, be determined upon, even from one change to another, much less of changes that may follow each other, weeks and months in advance. Though if any law in this movement of low and high barometer is ever discovered it will only be by the careful study of the weather as recorded on the weather map.

This may sometimes be the case, but the Signal office has advanced in its line of indications until they have made a record for a year of ninety-five per cent, in accuracy, and this must be acknowledged is not far from perfection. Why not have the indications right every time? Let one become familiar with this subject and he will readily see *why*.

There are many reasons why. There are many people of exacting nature in the world, who always want positive statements that such and such *will be* or *will not be* the case, and their natures cannot conceive any circumstances but what the human mind can control; and when "circumstances" is mentioned to them, they have no place for the word in their lexicons, and with Napoleon I. when in success, they exclaim, "I make circumstances;" by and by a Waterloo comes and they see perhaps when too late, that there are circumstances which even the strongest man cannot control. If in the affairs of men there are "circumstances" beyond the control of these strong men, much more are there circumstances in nature that man must abide by. Nature is endless in her varieties, and man is powerless to prevent or at all times even to foretell her exact course. Probably nothing better illustrates this than to pour some water down a slightly inclined plane and note its course. We know that water will run down hill, but it does not take what appears to be the most direct course. We know and can readily predict that it will take, if left to itself, a certain general course, but when the practical reality takes place, we not only discover that it takes a course of its own, but that it passes over certain lines and circumvents spots, even in so small a surface as a few yards in length, that it was and would be impossible for human knowledge to specify or indicate before-hand. This being the case in nature when confined to a few yards square, what must be the effect of an area of low-barometer passing over variable territory of more than a hundred miles square.

The Signal Office can tell the course of all regular storms, but occasionally there happens an irregular change, which is analagous to this running of water down hill, as seen in the course of almost every river large or small in the world.

In conclusion, I repeat there is no other reliable process than that of the Signal Service system, whereby we may foretell the weather. All other known systems, if I may so designate or honor them, whether founded on the conditions of the moon, the habits of animals, the relation of the other planets to the planet on which we live, or the guess-work founded or unfounded on the weather of previous years—all these I hereby pronounce the merest nonsense, if not something worse—and that all these things are unworthy of any man who makes any pretense to scientific knowledge or claims any standing in advanced society.

From Kansas City *Medical and Surgical Review*, No. 5, May, 1860: The amount of rain which has fallen since the first of January, 1860, is 6.60 inches, a smaller amount than has fallen here, in the same length of time, in any year since 1854, when there was absolutely no rain from June until October.

From a clipping of a Kansas City paper, September, 1860: August 21st, 1860, at the chemical works, Waltham, Mass., the rain gauge showed a fall of 5½ inches of water in a little over an hour.

THE BAROMETER.

SOME CONSIDERATIONS IN REGARD TO A VARIABLE SCALE OF PRESSURE PER SQUARE INCH FOR THE BAROMETER AT DIFFERENT HEIGHTS.

BY C. A. SHAW, U. S. SIGNAL OBSERVER, MADISON, WIS.

LOCAL SUMMARY FOR JUNE, 1880, MADISON, WIS.

DATE.	*Mean Daily Barometer.*	*Mean Daily Thermometer.*	*Rainfall or Melted Snow—Inches.*	*Prevailing Direction of Wind.*	*Weather.*
June 1	30.095	58.7	. . .	nw	Fair.
2	29.992	60.5	1.20	sw	Cloudy.
3	29.958	67.0	. . .	s	Fair.
4	29.687	65.7	1.03	se	Cloudy.
5	29.370	69.5	1.22	s	Cloudy.
6	29.419	59.5	.46	w	Cloudy.
7	29.888	63.2		w	Fair.
8	29.880	64.7	. . .	s	Cloudy.
9	29.656	71.7	.57	se	Cloudy.
10	29.793	76.5		se	Fair.
11	29.850	80.0		s	Fair.
12	29.782	79.0		sw	Fair.
13	29.800	72.2	.47	nw	Fair.
14	29.751	53.0	3.47	ne	Cloudy.
15	30.018	61.2	.20	ne	Fair.
16	30.189	68.0		nw	Fair.
17	30.177	71.7		se	Fair.
18	30.194	71.0		sw	Fair.
19	30.186	72.5		n	Fair.
20	30.094	76.0		w	Fair.
21	29.972	76.7		sw	Fair.
22	29.859	77.2		sw	Fair.
23	29.816	78.7		s	Fair.
24	29.752	74.0	.14	s	Cloudy.
25	29.750	74.0	.03	w	Fair.
26	29.812	75.7		e	Fair.
27	29.699	71.7	.19	s	Cloudy.
28	29.736	65.5	.14	nw	Fair.
29	29.805	65.0	.19	w	Fair.
30	29.873	68.7		sw	Fair.
Sums	. . .	. . .	9.31	. . .	. . .
Monthly Mean	29.861	69.6	. . .	sw	. . .

TEMPERATURE, BAROMETER AND WIND.

June, 1880.	*Highest Temperature.*	*Lowest Temperature.*	*Range of Temperature.*	*Barometer—Rising or Falling.*	*MILES WIND.* *From Noon to 6 p. m.*	*From 6 to 12 p. m.*	*Midnight to 6 a. m.*	*6 a. m. to Noon.*	*Total Miles Traveled.*	*Maximum Hourly Vel.*
1	69	50	19	. . . . . High	100	62	35	28	225	15
2	72	53	19		49	47	43	74	213	32
3	75	55	20	. . . . F	79	65	49	69	262	18
4	72	59	13		80	37	63	89	269	23
5	74	63	11	. . . . . Low	86	90	125	93	394	50
6	72	58	14	. . . . R	115	140	116	90	461	38
7	70	51	19		182	118	36	22	358	7
8	74	56	18		28	25	17	31	101	18
9	79	61	18	. . . . F	67	89	78	69	303	19
10	84	71	13	. . . . R	56	58	44	47	205	16
11	87	71	16		59	43	28	41	171	14
12	87	74	13		67	45	58	51	221	15
13	71	66	12		66	41	57	49	213	28
14	78	50	21	. . . . . F R	52	16	68	80	216	24
15	70	52	18		102	97	75	78	352	18
16	77	56	21	. . . . . High	83	40	40	29	192	8
17	81	62	19	. . . . F	23	6	15	15	59	5
18	78	64	14	. . . . R	20	20	19	12	71	7
19	83	63	20	. . . . . High	19	24	18	13	74	6
20	84	67	17	. . . . F	19	15	14	18	66	5
21	84	68	16		21	18	5	25	69	9
22	86	68	18		40	30	48	49	167	10
23	88	69	19		55	38	52	78	223	16
24	82	69	13		66	39	47	40	192	18
25	84	67	17	. . . . R	55	44	28	28	155	12
26	84	67	17		42	37	32	22	133	7
27	81	68	13	. . . . F	19	25	43	48	135	24
28	72	62	10	. . . . R	60	32	40	98	230	24
29	74	59	15	. . . . . F R	81	48	36	39	204	30
30	79	56	23		54	33	24	32	143	12
Sum	. .	. .	. .	. . . .	1845	1422	1353	1457	6077	. .
M'n	78.4	61.8	16.6	. . . .	61	47	45	49	203	17.6

Mean daily barometer, 29.861. Humidity, 71.4.

Highest barometer, 30.251 (19th).

Lowest barometer, 28.986 (6th).

Monthly range of barometer, 1.265.

Highest temperature, 87 (11 and 12th).

Lowest temperature, 50 (1st and 14th).

Monthly range of temperature, 37.

Greatest daily range of temperature, 23 (30th).
Least daily range of temperature, 10 (28th).
Mean of maximum temperature, 78.4.
Mean of minimum temperature, 61.8.
Mean daily range of temperature, 16.6.
Total rainfall or melted snow, 9.31 inches.
Prevailing winds, southwest.
Maximum velocity and direction, 50, south (1:15 a. m., 5th).
Total movement of wind, 6,077 miles.
Number of cloudy days on which rain fell, 9.
Number of cloudy days on which no rain fell, 0.
Number of days on which rain or snow fell, 16.
Rain or snow preceded by wind from southwest, 4 times.
Rain or snow preceded by wind from south, 3 times.
Rain or snow preceded by wind from southeast, 3 times.
Rain or snow preceded by wind from east, north and west, each once.
Clear days, 0; fair, 21; cloudy, 9.
Mean of barometer, corrected for temperature only, 28.938.

THE BAROMETER.

During the past month, the steadiness of the barometer was most noticeable. From the 16th to the 21st it was almost motionless with the least possible wind during that time. Even during the excessive rainfall of the 14th the barometer was of nearly normal height, and stationary. But then it is to be noticed that the wind was moderate in force and amount, while during the heavy wind storms of the fifth and sixth the variation was very great.

The barometer is a most valuable instrument, but the usual legends affixed, of wet and dry, and changeable, are mostly hypothetical. It merely measures the pressure of the air at the moment of reading. These, compared with other readings, may give data for deducing probable changes, but alone they are exceedingly vague. Consider that the amount of rain which fell in this vicinity upon the 14th would have made a solid block of ice with a square base the size of the park, three feet thick for every mile. What sustained this tremendous weight before the storm it is difficult to conceive. If the air rushed in to fill the space before occupied by vapor tension, destructive winds might have been expected. If the elastic force of the vapor exactly compensated for diminished pressure before, while the solid air compensated afterward, this implies two elements whose action upon the barometer are so similar as to make the real cause undiscoverable. There is certainly in most cases a great loss of power which, by calculation, should be expended.

For example. The force required to sustain a column of mercury 27.97 inches in height is 14.73 pounds. This is about half a pound per square inch of mercury. If during twenty-four hours the barometer should change an inch, this would give a total variation in pressure equal to about seventy-two pounds per square foot. The pressure of wind at different velocities is something like this: Two pounds per square foot for a velocity of twenty miles per hour, eight pounds for forty miles, eighteen pounds for sixty, thirty-two for eighty, etc. Seventy-two pounds for twenty-four hours would be three pounds per hour, equal to about twenty-five miles. Now, although twenty-five miles is accounted a fairly strong wind, it cannot be doubted that above the earth and free from obstructions, the velocity is greatly above this with a change of barometer of an inch. It seems hardly too much to calculate it as three or even four times as great. A scale might be constructed something like this:

Pressure of the wind above a place, free of obstructions, when the barometer at the surface was between

29.00	and	30.00	inches	—2	pounds	to the	square	inch.	
28.00	"	29.00	"	—1.75	"	"	"	"	
27.00	"	28.00	"	—1.57	"	"	"	"	
26.00	"	27.00	"	—1.31	"	"	"	"	
25.00	"	26.00	"	—1.20	"	"	"	"	
24.00	"	25.00	"	—1.10	"	"	"	"	
23.00	"	24.00	"	—1.00	"	"	"	"	
22.00	"	23.00	"	—0 90	"	"	"	"	
21.00	"	22.00	"	—0.81	"	"	"	"	
20.00	"	19.00	"	—0.73	"	"	"	"	etc.

This may be an exaggerated scale but, the principle seems to be correct. That the pressure of an elastic medium like the atmosphere would be very excessive in the high regions of the scale and of much diminished power in the lower, seems natural to conclude. Imagine how weak the force of the wind that corresponded to a pressure of mercury one inch in height, for while one inch of mercury weighs as much as another the wind producing power of the air at different pressures must vary.

Seemingly opposed to such a scale is the fact that the measure of the wind does actually correspond nearly with the barometric change. Take an actual case: At 6:00 a. m., June 6th, the barometer read 28.986, equal, we will say, to a pressure of 2086.56 pounds per square foot. At 6:00 a. m., June 7th, the barometer read 29.882, equal to a pressure of 2151.36 pounds per square foot, a difference of 64.8 pounds; about 2.6 pounds to the hour for twenty-four hours, about twenty-three miles. Though variable, of course the wind record from 6:00 a. m., June 6th to 6 a. m., June 7th, was 426 miles or about eighteen miles per hour, equal to a pressure of 162, a loss of five miles per hour, though as the wind was variable, running up at one time to thirty-eight miles, this loss may be excused or laid to natural obstructions at the place of observation. But it will be seen by looking at the scale of pressure and velocity that a running up of the force to forty or fifty miles quickly exhausts the pressure which the change of an inch implied. Besides which, this would not explain variations in force which occur at different portions of a storm's progress, while the barometer change remains nearly uniform.

It may easily be imagined that some compensatory phenomena transpire to prevent the very destructive winds which this implies; perhaps by *opposing* pressure, as, in mechanics, the exhaust of a low pressure engine is made to add to its working force. The means of determining vapor tension by the hygrometer are imperfect; but if it is this influence which affects the barometer it shows why local observations are so unreliable, for after all, to one dependent upon his own weather-glass, the following are about all the rules that have been given to guide him.

1. If, after a continuance of dry weather, the barometer begins to fall slowly and steadily, rain will ensue; but if the fine weather has been of long duration, the mercury may fall for two or three days before any preceptible change takes place, and the more time that elapses before the rain comes the longer the wet weather is likely to last.

2. Conversely with regard to a rising barometer and fair weather.

3. If the change ensues immediately it will not be permanent.

4. If, though rising steadily for two days together or more, it rains, yet fine weather may be expected; though if it begin to fall upon its appearance, the fair weather will not be permanent, and conversely.

5. Sudden falls of the mercury in spring or autumn, indicate wind; in the summer, during hot weather, a thunder storm; in winter, a change of wind with a thaw and rain, but in a continued frost, a rise indicates approaching snow.

The difference in value of these indefinite rules to a system of actual measurement of atmospheric phenomena, embracing a large extent of the earth's surface, can be readily perceived. Yet additional instruments are certainly desired; self-registers, delicate and reliable, and with the barometer, an associated instrument to define these disturbing elements which compensate, disadvantageously for scientific purposes, the actual changes of pressure which we know are continually taking place.

ELECTRIC ECCENTRICITIES.

Mr. James Johnstone sends to the *Edinburgh Daily Review* the following in teresting account of the effects of a thunder-storm observed on the 7th ult. He says:—"On the 7th ult., about 4:15 p. m. the lightning struck the craig which is named on the plan of Edinburgh 'The Dasses,' which overhangs the Hunter's Bog on the east. The results are so extraordinary that they are worthy of notice in your columns. The rock struck is of the hardest basalt, commonly called whinstone, The lightning did not strike the sharp, serrated, front edge of the craig, as might have been expected; but, on the contrary, it struck the flat top covered with sod at a distance of three feet from the present edge, and that must have been between six and eight feet from the edge before the accident; for the lightning detached several tons of the rock from the front of the craig, and sent six large masses of rock down into the Hunter's Bog. The largest of these measures four feet long by three feet broad and one foot thick, but of irregular shape. On the edge of the craig the lightning detached a mass of rock, which now stands in a very precarious position. This large mass measures four feet nine inches long by three feet broad and one foot four inches thick. The top of the craig, a short distance from the front of it, is covered with a coating of angular pieces of basalt, and on the top of these a covering of sod. It was on the sod the lightning struck, and made a hole two feet six inches long by one foot six inches broad. The largest diameter of the hole is in a direction from N. W. to S. E. and the lightning continued its course in this direction, ploughing a furrow in the sod for a distance of nineteen yards, the furrow diminishing in width as it receded from the original hole, where it measures five inches wide. These facts establish the direction in which the lightning came, and correspond with the observations of three gentlemen who were in a house on the west side of the Hunter's Bog, and saw the lightning pass across the Bog to the rock on the east side, namely from N. W. to S. E. In the *Times* of the 14th of October last, notice was given that a committee of scientific gentlemen had been appointed by insurance and other companies to investigate the effects of lightning with a view to providing the best means for protecting buildings, and a request was made that all persons who could furnish information on this subject would do so. In consequence of this notice I wrote a letter to the *Times* on the 25th of October, containing the following information, which it is important persons should know who wish to watch thunder-storms, and give the information asked. There are three kinds of thunder-storms. First, those that take place between clouds, the lightning flashing from cloud to cloud; second, storms in which the lightning comes from the clouds down to the earth; third, storms in which the lightning passes from the earth to the clouds. It is the two latter kinds of thunder-storms which affect the question of the protection of buildings. The damage done to them and to trees by lightning varies in a remarkable manner, according to whether the lightning went from the earth to the cloud or from the cloud to the earth.

"The lightning which struck the Dasses Craig has an important bearing with reference to the protection of buildings from lightning. The common theory is that lightning will always be attracted to strike the highest or most prominent point in its vicinity. The Dasses Craig is near the bottom of the valley, bounded by Salisbury Craigs on the W. and S., and Arthur's Seat on the E. High land and prominent rocks surrounded this craig on all sides, and yet the lightning passed all these and descended into the valley to strike it.

"Another interesting fact. On placing a compass near the hole made by the lightning I found that the needle deviated from N. to E., and when the compass was in the hole, the needle stood at E. S. E., instead of N., proving that the rock was still powerfully electrical at the spot where the lightning struck it. But, except in the vicinity of the hole, the craig did not affect the needle."—*The Telegraphic Journal.*

THE METEORIC SHOWER OF AUGUST 18, 1880.

PROF. S. A. MAXWELL, MORRISON, ILL.

On the night of the 10th of August the earth in its orbital revolution passed through the "meteoric zone." Observers throughout the country were on the lookout, and when twilight came had everything ready for conveniently noting each phase of the anticipated phenomena. From personal observations of this and several other meteoric showers of corresponding date, I am prepared to say this was one of the most interesting that has occured for several years. From 9.30 until 10.00 P. M., the number of meteors, according to the best estimate I could make, was six per minute.

For a time after ten o'clock the numbers preceptibly diminished and near midnight again became more numerous. I regret that I could not observe this interesting phenomenon after midnight, for without doubt the finest part of the display took place at that time.

In point of numbers, the display of 1880 as I observed it was not inferior to that of 1875; but in brilliancy it fell far below it. The larger number of meteors on this occasion, seemed to be in the direction of Ursa Major. I saw nothing unusual in regard to their apparent velocity or the direction of their flight. Very few of them were either marked by any red color or left any visible train of light.

Quite a large number of meteors were visible on the evening of the 11th, also on the 9th, some of which surpassed in brilliancy any that appeared on the night of the 10th.

I have neither the ability nor the disposition to enter into any speculations concerning these erratic bodies. Although much has been learned and satisfactorily explained regarding their composition, a definite knowledge of their origin has not yet been obtained.

PHYSIOLOGY.

DR. TANNER'S FAST.

(CONCLUDED.)

In our last number we gave the details of Dr. Tanner's fast up to the thirty-second day, at which time he had lost 30½ pounds in weight, but was in other respects in fairly normal condition. During the remaining eight days his condition, in brief, was as follows; Thirty-third day—weight 126½, pulse 78, temperatue 99°, respiration 9½; thirty-fourth day—weight 126½, pulse 78, temperature 99½°, respiration 14; thirty-fifth day—weight 126, pulse 78, temperature 98°, respiration 14; thirty-sixth day—weight 126, pulse 74, temperature 98°, respiration 14; thirty-seventh day—weight 125½, pulse 74, temperature 98¾°, respiration 14; thirty-eighth day—weight 123½, pulse 78, temperature 99¼°, respiration 15; thirty-ninth day—weight 122½, pulse 91, temperature 97°, respiration 13; fortieth day—weight 122, pulse 92, temperature 99°, respiration 17.

Thus terminated one of the most complete and satisfactory tests of human endurance ever witnessed, for though many cases have been reported in which abstinence from food has been protracted even beyond this, still there have been in none of them so strict a watch kept or so accurate tests made. As has been said by a well known writer: "The question of fasting is one of physiology. It is best explained by an examination into the nature of those animals that indulge in hibernation, as it is termed, almost, as it would seem, by instinct. The term means 'wintering,' but hibernation is practiced by certain creatures as much in summer as in winter. It would appear to be a plan devised by nature to enable animals that cannot change their *locale* readily with the changing seasons, to exist without food during the periods unpropitious to their obtaining it. Bears, bats, hedgehogs, the dormouse, water rats and certain insects are all addicted to this practice, but not alone in winter. The bat hibernates once every twenty-four hours, exhibiting all the customary phenomena of the condition. Not to be too scientific, it may be said that these include respiration and augmented irritability as attendant factors. Birds have high respiration and little irritability; reptiles are the reverse in this. In structural changes—as from the egg to the bird, the tadpole to the batrachian and the larva to the chrysalis and insect—respiration is augmented; in physiological changes, as in sleep and hibernation, it is lessened.

In winter the swallow and bat migrate to warm regions, while the insects—their natural prey—sink into a deep sleep through the season of cold and famine. With those animals that hibernate the question of fasting is necessarily involved with that of sleep. Yet there have been instances in which the latter condition was not certainly prominent. The capacity for existing without food would appear to depend on the ability of the heart to carry on the circulation of the blood without regard to the arteries. The blood in that case is venous and not oxygenated. In hibernation disintegration and waste of the tissues progress very slowly, and the animal is enabled to live on the slow consumption of its own tissues. Bears that come out after hibernation are found to be wasted greatly from this cause, and it is considered a positive evidence against the faster in cases of long abstinence from food being pretended, if he do not display this waste of his superabundant fat. It is, therefore, obvious that this condition of inactivity and that of a high temperature are of advantage to the voluntary faster. The consumption of tissue goes on less rapidly under those circumstances, and he is enabled to utilize the waste for the sustenance of his own life."

The period of forty days seems to have been regarded in Biblical times as within the possibilities, although evidently far beyond any custom or requirement of the Mosaic law. Moses, on Mt. Sinai, and after his descent therefrom, Elijah on Mt. Horeb, Jesus in the Wilderness, are marked instances of fasts of this duration. In modern times numerous cases are on record where religious enthusiasts have imitated the example of those sacred personages, but success has been rare.

The experience of physiologists, derived from the most careful and accurate experiments carried on for centuries by the most scientific men of succeeding periods, proves beyond question that the average man cannot live without food more than about ten days, and those persons and those editors of newspapers who think and say that this feat of Dr. Tanner's upsets the theories and reverses the teachings of physiologists and medical men, merely show their ignorance of the amount of labor, time and skill bestowed upon by such men their researches.

To the question *cui bono?* so often propounded during Dr. Tanner's fast, there have been many answers offered, the principal of which amount to this: 1st, We all eat and drink too much; 2nd, Fasting may be employed as a therapeutic agent. To the first of these it may be replied that to eat too little is at least as direct a violation of the laws of nature as to eat too much, and to the second it may be said that from the days of Esculapius until now, the best physicians have prescribed fasting in all diseases or injuries of the stomach or intestines, as well as in many other diseases of an inflammatory character.

Among the best articles that we have seen on this subject is one in the *Scientific American*, which we copy:

"That his experiment is not altogether useless, as is maintained by some, we will try to elucidate, notwithstanding we agree that the sacrifice and danger he exposes himself to appear so great that it is doubtful if they will be compensated for by the physiological and pathological lessons to be learned by it.

His fast has, in the first place, proved the mistake of those who judged all men alike, and reasoned that, because a weak, hysteric, and ill fed girl of 18, perhaps consumptive besides, died within two weeks from starvation, as soon as she was carefully watched, therefore nobody could be without food for a period of forty days, forgetting that the case is quite different where we have a man of between 40 and 50, the age of maximum resistance, a man well fed, of whom the weight is far above the average for his size, and who was provided with a copious layer of adipose tissue around his body, a man who had practiced fasting for sanitary purposes, finding it the best way for him to cure gastric derangements, for which he had a liability, and who had gradually increased the time of fasting until, at his last fast in Minneapolis, he had extended it to forty-two days. This was not believed, and deception suspected, hence a challenge of $1,000 if he succeeded when carefully watched. Dr. Tanner accepted, but the challenger backed out under some pretext, and Dr. Tanner, to save his reputation and prove his theory, came on and submitted for nothing to the task under the eye of careful watchers.

It must be conceded that few persons would possess such a strong will and determination to persist in subduing all appetite, and disregard the no doubt exceedingly disagreeable and perhaps distressing feelings consequent to total abstinence from food; but Dr. Tanner possesses this determination in the highest degree, and he never thought of cutting the fast short, whatever may sometimes have been the opinion of his watchers.

In order to understand what may be learned from this experiment we will, for the benefit of the non-professional reader, remind him of a few physiological principles.

The chemical constituents of the human body have to be constantly renewed, and the waste has to be supplied by the food. Some of these constituents are wasted rapidly, others slowly, and in case of starvation the elements rapidly wasting away must be present in the body in sufficient quantity to keep the functions of life in operation. These rapidly wasting constituents may be divided into three classes, those in which carbon prevails, those in which nitrogen, and those in which phosphorus is the prevailing element.

The carbonaceous compounds are wasted in keeping up the animal heat. This is accomplished by a slow combustion, that is, a combination of the carbon with the atmospheric oxygen, which is continually going on in the capillaries through the whole body, the oxygen being furnished by the blood, which absorbs it into the lungs, and which by the arteries is sent through the body. The product of this combustion, the carbonic acid, still absorbed in the blood, is by the veins sent to the lungs, where it is given off and escapes in the act of respiration. After having stripped Dr. Tanner, when he commenced his fast, for the double purpose of ascertaining his physical condition and leave no doubt that he had no food about him, it was seen that he had plenty of fat in and around his body to furnish carbon enough to last him more than forty days.

The second element of rapid consumption is nitrogen; it proceeds from the waste of the muscular tissue, which is always going on, even during sleep, as the heart is a muscle continually contracting, and respiration is kept up by muscular action. The blood takes up this waste in the form of a compound, of which the chemical name is cyanate of ammonia, but which by physiologists is called urea. It is the function of the kidneys to secrete this from the blood, and numerous experiments have settled the nature and amount of this secretion, which in healthy persons consuming food, varies from 25 to 35 grammes every twenty-four hours. When Dr. Tanner began his fast it was secreted at the rate of 29 grammes, and as the nitrogen in any excess of nutrition is similarly changed and secreted, it was expected that a large reduction would be observed as soon as the fast began to have effect on the system. This expectation was realized, and the amount soon fell off to 23, 20, 17, 16 and finally 13 grammes, at which it remained stationary, with slight oscillations beyond. This amount of nitrogenous substance represents, therefore, the waste necessary to sustain the functions of life, and would at once be increased in case food was taken by the experimenter, at least nitrogenized food, such as beef extract or its equivalent, albumen, casein, milk, etc., the only substances which would be of benefit to him. Analytical chemistry, therefore, acts here as a reliable detective, and to the credit of all concerned it must be said that never the least suspicious increase of urea was observed, it remaining very nearly constant, and will no doubt become double and more as soon as after the fast food is again taken.

The third element of rapid waste is the phosphorus; it proceeds chiefly from the waste of the brain and nervous tissues. It is so important in these functions that a great German chemist has formulated the expression, "without phosphorus, no thought." Every mental act and every nervous excitement is accomplished by a consumption of phosphorus, which, combined with different bases in the body, especially soda, magnesia, and lime, is secreted by the kidneys as a soluble salt, not only easily detected as crystals by the microscope in the sediment, but even an approximate estimate may be had of its reduction or increase by the number of crystals seen in the field under the same circumstances.

This third element did not at first show any reduction in quantity, but, to the contrary, for a few days some increase. It was at the occasion that Dr. Tanner had been unjustly accused by a physician present that he had surreptitiously accepted food from one of the watchers; this appears to have preyed upon his mind. Attention was therefore called to the danger in this direction, a danger proceeding from the more rapid waste of the nervous system. Relaxation was therefore devised, and daily carriage rides, which eased his mind and were followed by a more sound sleep, soon reduced the phosphates secreted, and at the same time reduced the irritability and temper of the experimentor.

The observation tallies perfectly with what has been observed in the case of such clergymen who have every week the periodical labor of preparing and delivering two sermons on Sunday. Chemical analysis has proved that at that time they secrete more phosphates than in the middle part of the week, after the rest of Monday and Tuesday.

Looking the whole case over, including the feasting as well as the fasting, we are inclined to regard the Doctor's individual stomach as the most remarkable organ on record. That he could, by mere force of will, compel it to do without food for forty days, is, in our judgment, far less remarkable than that he could, at the end of that time, when it had, ostensibly, become so sensitive as not to be able to endure even a few spoonfuls of water, with impunity stuff it with an incongruous and incompatible mass of milk, watermelon, peaches, oysters, bananas, beef, etc., etc., and that, too, without a sign of resentment from it.

The principal lessons, if any, to be learned from this feat are, that occasional men can do like the prophet Elijah, who, before his fast on Horeb, "did eat and drink, and went in the strength of that meat forty days and forty nights;" *i. e.*, they can fill up like sponges and live upon their own gradual waste, like bears and groundhogs, or like an old log slowly rotting in a forest; that some men have a vast deal more control of their wills than others; and finally, that some men have stomachs and absorbents that can withstand treatment which would prove fatal to most human beings. Taking this view of the case, it is very clear that had Dr. Tanner remained quiet, instead of taking his walks and rides, he could have easily have extended his fast for another ten days by living on the tissues wasted by this muscular action.

EXPERIMENTS IN ABSTINENCE FROM FLUIDS.

PROF. E. T. NELSON, OHIO WESLEYAN UNIVERSITY.

Dr. Tanner has well-earned the title of the "Fast-Male," by his remarkable experiment and its successful termination. As illustrating the power of the will over the physical nature of man, the experiment is the most important ever recorded. The Doctor seems to have gained nourishment as well as consolation from a sip of ice water.

The details of an experiment of an exactly opposite character may not be without interest. In 1878 Mr. Charles King, a student of this university, had his attention called to the subject of water as an article of diet and to the writings of our leading physiologists on this subject. He found Dalton saying, "Water is probably the most important substance to be supplied with constancy and regularity, and the system suffers more rapidly when entirely deprived of fluids than when the supply of solid food only is withdrawn."

Flint claims, "the body only requires not less than three pints of water to two and a half pounds of meat, bread and other solid food daily."

Mr. King resolved to avoid the use of all fluids in his diet in order to test the effect upon his system. The experiment began on the first day of September. The weather was very warm and sultry. The diet consisted of bread with a little butter, meat and potatoes, but no tea, coffee, milk, water, gravy or other fluid. His appetite, only moderate at first, increased regularly during the whole time of the experiment. His pulse was low but very regular, and the general tone of the system good. At the end of thirty days he gave up the investigation because informed by his friends and physicians that it must prove injurious. During the first week in October he drank very moderately of water, consuming during the seven days exactly one quart. He then resumed his experiment for another thirty days, only under a more complete supervision of his diet, so as to avoid the use of any article that contained much water. During this month he took no fruit, nor vegetables of any kind except potatoes. No special change in his symptoms or feelings was observed during the second experiment. After the first few days all sensation of thirst disappeared, and as Mr. King expressed it, "I never felt better in my life."

During the whole period of two months he took much exercise and was a close faithful student. It should be stated that just before entering upon these investigations Mr. King had used milk and water very freely, perhaps to the extent of two quarts per day.

August 7, 1880.

ASTRONOMY.

PLANETARY PHENOMENA FOR SEPTEMBER, 1880.

BY W. W. ALEXANDER, KANSAS CITY.

Mercury, during this month, is in an unfavorable position for observation, except in the beginning, when it may be seen before sunrise in the morning.. It rises on the 1st at 4 hours and 18 minutes a. m., Kansas City mean time; sets on the 30th at 6 hours 4 minutes p. m., and is in superior conjunction with the sun on the 17th 3 hours a. m.

Venus may be seen in the evening twilight during the entire month. It sets on the 1st at 7 hours and .05 minutes p. m., 30th at 6 hours 33 minutes p. m. On the 7th it is in close conjunction with Mars, being only 31 minutes of arc north of that planet (or about the diameter of the moon).

Mars being too near the sun and nearly at its maximum distance from the earth shows to a poor advantage. It sets on the 1st at 7 hours 11 minutes p.m., on the 30th at 6 hours 00 minutes p. m., and is in close conjunction with Mercury on the 28th; distance 6 minutes of arc north.

Jupiter, together with its four moons, forms a superb object for the telescope during this month, rising as follows: On the 1st at 8 hours and 4 minutes p. m., on the 30th at 6 hours and 5 minutes p. m.

The moons, as they course round the primary in their orbits, present some interesting phenomena, of which the following are the most important to be observed at Kansas City. On the evening of the 3d at 10 hours and 34 minutes, the 3d satellite may be seen to emerge from behind the body of Jupiter or re-appear after occultation.

On the 5th at 11 hours 27 minutes p. m. the 2d satellite may be seen to enter on the planets' disk, preceded by its shadow, 1 hour and 36 minutes, both of which can be seen on the disk of the planet at the same time.

On the 7th at 00 hours 28 minutes 11 seconds a. m. the 1st satellite will suddenly disappear by entering the shadow of Jupiter, and will reappear, coming from behind the planet at 3 hours 24 minutes a. m.

The same occurs again on the 8th, the reappearance being at 9 hours and 50 minutes p. m.

On the 10th the 3d satellite enters the shadow of Jupiter and disappears at 9 hours 00 minutes 32 seconds p. m., and reappears at 11 hours 28 minutes 51 seconds p. m., and remains visible 23 minutes and disappears behind the planet's disk for more than two hours.

On the 12th the 2d satellite again makes a transit together with its shadow as on the 5th. On the morning of the 14th the 1st is again eclipsed. And on the evening of the 14th the 2d satellite reappears after occultation, at 11 hours, 11 minutes.

On the 15th, 8 hours, 51 minutes, 32 seconds, the 1st satellite is eclipsed as on the 7th. Similar phenomena to the above happens on the 16th, 17th, 19th, 21st, 23d, 28th, 29th and 30th.

Saturn forms another imposing object for examination this month. Rising as follows: On the 1st, at 8 hours, 36 minutes, p. m.; on the 30th, 6 hour, 36 minutes, p. m. The southern surface of its rings being now presented to the earth, we look down, as it were, from an elevation of 15 degrees above the plane of the rings.

Uranus is badly situated for observation, being in conjunction with the sun; it rises on the 1st with the sun; on the 30th at 3 hours 47 minutes, a. m.

Neptune rises on the 1st, 9 hours, 15 minutes, p. m., and on the 30th at 7 hours, 19 minutes, p. m., and is nearly at its maximum brightness, but needs only be looked for with a telescope.

Our Moon is in conjunction with Mercury on the 3d, Uranus and the sun on the 4th, Venus and Mars on the 5th, and passes 6 degrees, 57 minutes north of Jupiter on the morning of the 20th, 3 hours, 6 minutes, and reaches Saturn 11 hours, 17 minutes in the evening of the same day, passing to the north 7 degrees, 41 minutes, and on the morning of the 21st at 4 hours, 34 minutes. Neptune lies to the south 5 degrees, 43 minutes of arc.

A NEW PLANETARIUM.

The old-fashioned orreries, which were constructed to show the arrangement of the solar system and the motions of the planets around the sun, were somewhat rude in their mechanism, and were apt to mislead from the conspicuousness of the rods and wires by which the astronomical movements were imitated.

Signor N. Perini, an Italian long domiciled in London, and whose name is well-known as a successful teacher for the civil service and the army, has invented a new planetarium which is free from most of the defects of its predecessors.

A high circular chamber or box, standing on twelve wooden pillars, is erected in the midst of an ordinary-sized room, with a ceiling higher than usual. On entering underneath this chamber, and looking up, a dome is seen, deep blue, and sprinkled with stars. The chief northern constellations are in their proper places, and round the base of the dome are the names of the signs of the zodiac.

Suspended from the top of the dome by a narrow tube is an opal globe, lit inside with gas, and representing the sun. From wires almost invisible the planets are suspended around the sun, of sizes and at distances approximately proportionate to the real sizes and distances, and each having the proper inclination to the plane of its orbit. The various moons are in their places, and Saturn has his rings.

Thus far, however, all these miniature celestial bodies have been in a state of quiescence. Presently Signor Perini, by simply turning a key, sets the solar system in motion, slowly or swiftly, as he pleases. The sun turns on his axis, and the planets revolve around the sun in proper elliptical orbits, which are traced around the inside of the dome, which is 14 feet in diameter at its base and 14 feet high. By an ingenious watch-work arrangement inside the earth, which is the size of a walnut, our world is made to revolve on its axis, which latter always points to the same quarter of the heaven. In like manner the moon goes round the earth.

The machinery is arranged in the chamber above the dome, clock-work being the motive power, the originality in the arrangement being the method by which the inventor effects the elliptical motion of the planets. Not a sound is heard ; the machinery works, like its great prototype, in solemn silence.

Signor Perini, who has been prompted to this work solely from the enthusiasm of a mechanician, has devoted his nights and mornings to this structure for seven years, and has spent on it about £700. The earth alone cost £40. The planetarium can be made of any size, from the dome of St. Paul's to a little thing that might be used for school instruction. It is now standing at 77 Newman Street, Oxford Street.—*London Graphic.*

GEOLOGY.

GEOLOGY AND EVOLUTION.

BY THE LATE PROF. B. F. MUDGE.

CHAPTER VI.—ARTICULATES.

CRUSTACEANS.—TRILOBITES.—DEFECTIVE RECORDS.

The fourth sub-kingdom of animated nature, the Articulates, appears with the first fossils of the lower sub-kingdoms, at the opening of the Silurian Age. By the symmetrical laws of evolution, these should have made their appearance only after time had allowed them to become developed from the lower sub-kingdoms. It is also not a little remarkable that with the first evidence of any of this division we find distinct traces of a class of animals whose bodies had no solid substance. The trails of worms (Annelids) with casts of their burrows remain to show their existence, and 185 different species have been described from the Silurians. Their existence affords us another significant fact, that animal life however soft or frail, may show its character, even from the oldest geological strata. It tells us that we have a right to expect, in some way, the trace of any class of animals that has been an inhabitant of our planet.

Ostracoids appeared with the worms, and with their minute, frail shells have existed through all geological periods.

Let us now examine a single form of Crustacean through a long geological period, and see the progress or want of progress, which it may make in the scale of being. Taking one of the earliest and most common, in species and individuals and most widely disseminated, we will examine its history. This is the Trilobite. It is seen in all the twelve distinct regions of the Silurian, represented by hundreds of thousands of well preserved specimens. It is found in the lowest beds of the Cambrian and abounds till the close of the Permian. There are about two thousand known species, but all are characterized by three lobes in the body—a buckler, also divided into three lobes and compound eyes. They are equally well characterized by an absence of any *fossilized* organs of locomotion, though from their known relations to other Crustaceans they must have had them.

These traits they retain in all the varied species throughout their long geological life, ending with the highest strata of the carboniferous age; or covering nearly three fourths of the whole of the earth's geological history.

The Trilobites are not the lowest of Crustaceans, but of "highly complex and specialized types, and remote from the embryonic stages of the group to which they belong."* They border on the Tetradecapods or middle rank of the sub-kingdom, but in all this long period of existence they never became Tetradecapods, or, in short, anything but Trilobites. There was time enough, and change in the earth's condition sufficient to have shown evolution, if it had been a law of nature. The Trilobites, according to Dana's time ratios then existed 37,500,000 years without losing their characteristic forms.

It is a cardinal principle of evolution that "the use of an organ developes it."† The Trilobites in common with all other Crustaceans must have had organs of locomotion, and some faint impressions on sand are supposed to have been made by their feet; but these organs were so thin or foliaceous that they have never been found fossilized, and this, too, at a time when rain-drops were imprinted on the rocks, and are seen to-day so delicately outlined that even the direction of the wind is known that attended the shower. Now if use of legs develops them, surely during 37,000,000 of years or as many generations, they should have become sufficiently firm to have left their shelly structure, or at least the impress of their feet beside the rain-drops.

The arm of the blacksmith is indeed stronger for its use, but a life-long hammering adds no new muscle to it, and leaves so slight a mark on the bone that the anatomist cannot enter the catecombs and select a humerus, and say, "This is from a blacksmith," even though, as in Europe, father and son for many generations follow that employment.

*Dawson.

†Thomsson.

It is claimed that the later Trilobites are somewhat more highly organized than the earlier; but Barrande on the other hand says, that those of the first or oldest Trilobite fauna, of the Silurian, rank above those of the second or more recent fauna. No proof exists, according to the same authority, that one genus has been derived from another.

Against this strong array of geological facts, which we have given in the preceding pages, so adverse to the doctrine of evolution, it is urged and objected that the geological record is exceedingly imperfect, and if no fossils were missing we should have evolution in all its phases. That this record, as we now know it is opposed to their theories, Prof. Darwin and his associates freely admit. He candidly says: "But I do not pretend that I should ever have suspected how poor was the record in the best preserved geological sections, had not the absence of innumerable transitional links between the species which lived at the commencement and close of each formation, pressed so hardly on my theory."‡ We admire the free, frank honesty of Prof. Darwin, that in his estimation, the strongest proof of the defectiveness of the record, consists in the fact that it does not agree with, but is antagonistic to his theory. If it is so defective, should not evolutionists and anti-evolutionists both wait till a better knowledge of these records shall be obtained from the rocks of the unexplored portions of the earth? If we had supposed this record were as deficient as Prof. Darwin concludes, we certainly should not have written this brief essay, endeavoring to show that its facts did not accord with evolution.

But is the record of the rocks so deficient? We have now 50,000 known and described species of fossils. Deducting the plants (6,000) and the articulates, and we have about 40,000, representing the four sub-kingdoms of Protozoans, Radiates, Mollusks and Vertebrates. Agassiz,* a few years ago estimated the living representatives of these four sub-kingdoms at 45,000, of which less than 30.000 had been described. Here, then, we have a fossil representation of species even larger than the living which have been described. But as there were, during the long geological ages, many more species than those living at any single period, we may estimate the total extinct of these four sub-kingdoms at 200,000, or at most 300,000 species. Are not the 40,000 species, scattered from the Archæan to the recent, likely to give us a fair representation of the varied life which covered that whole lapse of time? Does not our knowledge of the living fauna teach the same fact? We certainly had a correct knowledge of the zoölogical features of South America when our naturalists had described one-tenth of its fauna. The first explorers of Australia reported a fair synopsis of the peculiarities of the zoölogy of that region, ere they had penetrated fifty miles from the sea coasts.

So, while we have a meager list of the animal life of the carboniferous age, no one doubts that we possess a correct idea of its peculiar fauna. A perfect list of all its mollusks, insects and reptiles would not be likely to enlarge our

‡Origin of Species, Chap. X, p. 282, Amer. Ed.

*Principles of Zoology, p. 27, Edition of 1871.

knowledge of the true feature of the animals, which pervaded its oceans, swamps and forests. We have probably a small list of its plants, but no one supposed that dicotyledons flourished in that era. The labors of the past thirty years have tended to push back in geological strata some forms, but has not shown a change of type. Reptiles are now known to be older than when our list was half as numerous, but the forms are no lower. The pines are now gathered from the upper Silurian, when not long ago we had found them no lower than the Upper Devonian. But the normal trunk, fruit and cell form do not differ from the two horizons.

While in every locality some breaks are found in the geological deposits, yet the missing portions, to a very great extent, are seen in other countries. In Russia there is a blank between the upper Carboniferous and Permian, but in Kansas and Nebraska no such imperfection occurs, and the fossils pass from the lower of the one to the higher strata of the other. The great divisions of the geological formations in Europe are not tne same as those in America. The three epochs of the Tertiary in the former, become four in the latter, thus helping the defective record. Some of the American are fresh water deposits, synchronous with those of the salt water of Europe. According to Cope and Hayden, there is an unbroken continuation of the deposits of the Cretaceous and Tertiary ages, "establishing an uninterrupted succession of life across what is generally regarded as one of the greatest breaks of geologic time." * * * Types of lizards and tortoises continue, like the crocodiles, from the Mesozoic to Tertiary time without extraordinary modification of structure."†

But this "uninterrupted succession of life," connecting these two ages, covers the spot where we should find the missing links, which should, according to the theory of evolution, show the ancestry of all our extremely diversified mamal life of the early Eocene; yet, not a trace of any has been found. The great variety from Lemur to Marsupial, in the latter formation, demanded nearly as much variance of form in the connecting deposits, and thence shading backward to the primitive type as low as the Ornithorynchus.

Those who contend that our mammals are derived from a more simple quadruped should produce the facts which show it. Should true mammals or a high connecting form of marsupials be hereafter discovered below the Eocene it will then be soon enough to consider what theory they will sustain. We apprehend that they will be more likely to show forms as diverse from each other as the members of the Tertiary fanna.

The Wealden epoch in England and similar deposits in the "Foot-Hills" of Colorado very nearly cover the chasm which exists in other parts of the world between the Jurassic and Cretaceous. Thus we have a continuous succession of land through that portion of the earth's history in which are the records of all the highest members of the animal and vegetable world.

Our American fourteen divisions of the Silurian and nine of the Devonian

†U. S. Geological Survey of Colorado, 1873, p. 442, Hayden.

do not cover the exact divisions of those formations in the old world, as given by Lyell. Even in the United States, what is wanting in one section, is, in part, supplied in another.

Had not the 10,000 species described from the Silurian failed to show the missing links to sustain the theory of Prof. Darwin, neither he nor any of his followers would have supposed that they were not a fair and full representation of all the types that existed in that geological age. Nearly 1,000 species of plants are known from the Carboniferous, and there is no probability that any new type of vegetation will be found in it. With all the numerous and extremely diversified genera and species of reptiles from the Mesozoic, more varied than all the living, does any one expect that a more perfect list will change the characteristic feature of the age of reptiles? If the reader will look at tables one and two, page 19, or tables eleven and twelve, page 60, he will see the extreme difference between theory and known fact. The most sanguine evolutionist and most earnest pleader in favor of the imperfection of the geological records must admit that there can be little if any possibility that nature has made so imperfect a record of her doings as to leave us a history so entirely different from her true operations. The discrepancy is too broad and too deep to admit a probability that all the fossils showing evolution have been destroyed, while such a large number, covering the same periods, have been preserved as a record against it.

THE LOESS OF THE WESTERN PLAINS—SUBAERIAL OR SUBAQUEOUS?

BY A. L. CHILD, M. D., PLATTESMOUTH, NEB.

The geologists of the day are divided in opinion as to the method of deposit, of the Loess formation of the western plains. From the earlier observations of this formation by geologists till quite recently, the idea seemed generally, at least tacitly, to prevail, that like the large portions of the earth's crust, it was deposited under water, or was subaqueous in its formation.

Nevertheless it was frequently noticed and recorded, that wherever the formation was exposed the evidences of stratification were very obscure, if not entirely wanting.

The position taken by Baron Richthofen, that it was a product of the winds brought in from surrounding lands, or of subaerial formation, induced more active thought and inquiry on the subject.

Positive evidence of stratification, although earnestly sought for, eluded observation; and yet a deposit of the depth of the Loess from 150 to 200 feet, or in fact of any depth, distributed over such an immense surface, so nearly approaching a water level, indicated no hitherto observed or known action of wind.

In the great cutting for an approach to the west end of the C., B. & Q. R. R. bridge, over the Missouri, at Plattesmouth, this question is most conclusively solved. This cut, of upward of 2,000 yards in length and ranging from ten to ninety feet in depth, is entirely in the Loess formation. A portion of the excavation was made during the months of November and December of 1879, under very unusual circumstances. It was very dry, and yet there was a succession of a number of long mist-like rains. And during this period of these rainfalls there was hardly any perceptible wind.

The rainfalls were simply sufficient to moisten the smooth sides of the cut, without any wash, or disintegration of the surface. The result was an oxydized efflorescence of minerals unequally distributed, at different horizons. This oxydation produced distinct color lines, clearly revealing stratified deposits of from three to twenty inches in depth.

Subsequent heavier rains, with winds, largely mixed and removed these colors; yet some still remain quite distinct after an exposure of from three to six months.

Since reaching the grade level (some sixty days), several rather severe storms have fallen. The line of the cut, somewhat tortuous, offers faces, on the one side or the other, to any and all points of the compass. And those portions of the walls which have been subjected to a certain kind and amount of wear from these storms, exhibit clear and distinct lines of stratification; their lines of softer material being removed from between the different strata of from three to fifteen inches in depth.

Portions which have exhibited these lines clearly, are now by further action so far broken down and disintegrated that they yield no evidence of stratification, thus exhibiting the method by which all lines in exposure of this formation have been obscured. Many of these strata, under the peculiar action of the storms, are again subdivided into deeply cleft paper-like thicknesses.

Near the east end of the cut is a very interesting exhibition of the debris of an ancient iceberg. This debris so far as exposed (the cut passing through one side of it), is in a conical heap of ten feet in height, and about eighty feet in diameter. The material is of such a diversified character as could only be obtained by a very long travel as a glacier, till it reached the shores of the great lake which then covered these Loess plains; into which it fell, after the manner now frequently seen, on the coasts of Greenland, of the glacier breaking from the mass and floating off on the ocean as an iceberg. So this glacier became an iceberg and floated southwardly, till it was stranded at this point; and here in time dissolved and deposited this as yet unknown amount of debris.

The remains of this iceberg give us both indirect and direct evidence of our theory of subaqueous deposit. Indirect—by this proof of an extensive inland water, on which alone this berg could be transported. And direct, by the distinct lines of stratification, both in colors and weathered lines, passing conformably over this mound of debris.

Any honest doubter of the subaqueous theory can drop his doubts into the debris of the past on a brief examination of the evidence which this cut now exhibits.

EXPANSION OF CLAY.

From proceedings of the Institution of English Civil Engineers, March 26th, 1879:

In railroad tunneling, timbers were frequently broken by the expansion of clay, although it appeared quite dry.—*Hawkshaw.*

In Primrose Hill and the Kilsby tunnels, if the cutting was left a few days without completing the brick arching, the timbers were broken. The expansion seemed to be nearly the same, whether caused by the air as in the former case, or by the water as in the latter instance.—*Mr. Foster.*

That in the Box tunnel it was usual to leave six inches for expansion between the face of the work and the timbers, and that space was scarcely sufficient.—*Mr. Thompson.*

Had seen, at Richmond, a well of four feet in diameter, completely closed in one night by the swelling up of the bottom, although there was not any water in it.—*Mr. J. Simpson.*

The first stone bridge ever constructed in England was that of Bow, near Stratford, in 1087: the next oldest was London bridge, constructed in 1176.—*English Paper.*

ETHNOLOGY.

THE DECREASE OF THE NORTH AMERICAN INDIANS.

It is an almost universally received statement that, ever since the first contact of the whites and Indians, the latter have been steadily diminishing or disappearing. The matter has elicited repeated comment on the part of thinking men and philanthropists in this and other countries. It has furthermore formed no uncommon theme of earnest debate and somber prevision among the Indians themselves. And yet to ascertain the exact truth in the case is no easy task. Ignorance of the real facts has given rise to much of general assertion and idle sentimentation, and with the unthinking, careless or unmeaning generalities have come at last to be accepted as definite and indubitable data. A few additional words, therefore, upon this subject may not be altogether inappropriate.

That there has been in case of perhaps every one of the best and longest known Indian tribes a decrease, in many instances startling in its apparent rapidity, no one attempts to deny. Still the true rate of decrease is generally greatly exaggerated. The number of the aboriginal population in earlier days has been almost universally overstated. In the mind of the European explorers the vast expanse of the country seemed naturally to corroborate the boastful claims made by the Indians as to their numbers. Hence the comparison of tneir numbers as reported by these explorers, and subsequently by those who have simply repeated their estimates, with their now more accurately ascertained numbers makes the rate of decrease appear much greater than it actually is. In close connection also with this fact it must be remembered that the Indians (*as Indians*) are not a prolific race. To one at all familiar with Indian life and history this is a most obtrusive characteristic. With the normal birth-rate continued it is that under the most favorable circumstances in their mode of life the numerical increase of a tribe from generation to generation would be very perceptibly below the ordinary rate of increase among the whites. Notwithstanding their constitutional vigor and permitted polygamous life, the children of an Indian family that survive infancy rarely number five, and quite usually are only two or three. And the statement admits of demonstration that at times tribes in a state of ordinary prosperity scarcely more than hold their own from year to year in point of numbers.

Again, in some cases small tribes and remnants of tribes, instead of perishing utterly, as is often stated of them, are merely incorporated into the larger contiguous tribes and so disappear only in name. In frequent individual instances, too, Indian blood is simply absorbed by the whites. Whoever is conversant with the older and more recent Indian history and border annals meets constant evidence of such incorporation of Indian blood into white stock. Personal observation in all parts of the country presents not infrequent illustrations of the same fact. The degree to which this silent transference has occurred is far higher than is usually supposed.

But after all, the considerations just adduced do not invalidate the fact of a significant decrease among the Indians; they only call for an abatement in the rate. And this brings us to the real question, why is this decrease? What are the active causes that have borne part in producing it?

Undoubtedly the most noticeable agency has been war among themselves and more especially with the whites. Warfare is the Indians' inspiration, his chief avenue to tribal position and influence. In his view, life and warfare are quite interchangable terms. Their wars with each other, however, though incessant, are seldom bloody or to any considerable extent destructive of life. The Indians' proverbial fear of death is generally a sufficient motive to him to forego the shedding of the blood of an enemy wherever it seems likely to involve too great a peril of his own life. Intertribal warfare, therefore, consists mainly of petty forays, made by small parties or single individuals, and entailing comparatively unimportant destruction of life. To be sure there are instances where entire tribes are reported to have been annihilated, but these are exceptions. Such destruction has had place, if at all, only where combined action on the part of many, a rare event among Indians, has been made against the few; or where both sides have been encouraged or supported by outside influences. It is rather their wars with the whites that have proven disastrously destructive. The combined and long continued operations of the latter are at once impossible to them and altogether disconcerting. Statistics show that they have been fearfully reduced by this means. Their diminution in battle and indirectly by consequent famine and exposure has been enormous. The habitual secretiveness of the Indian renders it extremely difficult to carefully estimate these losses; but the lapse of time displays their magnitude only too distinctly. It must be borne in mind, moreover, that the losses of declared hostilities, great as they are, constitute but a small part or the actual losses inflicted upon them by the whites. The quiet taking-off of an Indian here and there by the irresponsible frontiersman has in the aggregate reached an almost incredible figure.*

To such a degree has this unreported decimation of Indians prevailed that universally they are now become extremely reluctant to place themselves in immediate constant contact with the whites, even under the most solemn assurance of amity and protection.

The crowding of the Indians in the advancing occupancy of their domain by the whites has been another important cause of decrease to them. The restriction of their wanted limits rendered their former active life a self-support by the chase impracticable, while as yet no adequate encouragement or assistance in the adoption of new modes of life, made necessary by their changed circumstances, was afforded. Hence was engendered a life of idleness, mendicancy and dissoluteness—a most fertile source of decay. Almost constantly during the past one hundred years our frontier has been beset with a pale of degraded, diseased and perishing red men of this description. Pressed back by the encroachments of civilization from their original homes, and not able successfully to maintain their new ground against wary assaults from its former occupant they are surely (and not slowly) borne onward toward extermination. Disregarded by the whites and despised by the adjacent wild tribes they have realized but too clearly that there was no place for them, and with perhaps fitful remonstrances have submitted hopelessly and aimlessly to the inevitable. Experience seems to indicate that when once the Indian has reached this state there is scarcely any help—his doom is set as he is consciously and almost willingly hastening toward it. The census of such tribes, as annually taken, is sufficient witness to their decline. A single illustration of this assertion, afforded within the last half dozen years, may be cited. One of the most robust and spirited tribes of the West has decreased 40 per cent. since 1874, in consequence mainly (if not entirely), of the limited and almost helpless conditions of life that have been forced upon them by the government.

*To learn what is the prevalent animus of the borderer toward the Indian one has but to refer to the discussions of the vexed *Indian question* constantly appearing in the journals of the frontier States. The general tone of feeling there evinced is decidedly inimical to them. Witness the following from the California correspondence of the New York *Tribune*, September, 1859: "The federal government committed a great mistake ten years ago in not ordering a large military force to this State, with orders to hunt and shoot down all the Indians from the Colorado to the Klamath. This would have been the cheapest method of managing the Indian affairs of California; and perhaps the most humane ——. The fact is that every wild Indian in the State must die ——. It is supposed that ten years ago there were 60,000 Indians in the State; to-day there are not 10,000." Compare Harpers Monthly, vol. 23, pp. 312–13. Unfortunately the press of the older States too often lends its sanction (perhaps unintentionally) to teaching of this character.

Cognate and suggested by the foregoing has been a more subtile but very powerful influence,—discouragement. The lack of organizing and recuperative faculty in the Indian has been frequently remarked. He seems incapable of unintermitted activity and complex combinations. Even periods of success are with him, inevitably followed by long lapses of relaxation and almost demoralization, when all his energies of both mind and body seem unstrung and insusceptible of reanimation. Much more is this the case in the presence of a long series of disasters and discouragements. More or less this fact of a general dispiritedness is become prevalent among all the Indians of our present territory. It may not at first acquaintance be noticeable, for as occasion requires the Indian can be a diplomat of no mean order; but to one long familiar with them in their daily life and thought it is a most impressive and unavoidable conviction that they are disheartened. Their ambition as a race is fast disappearing and their hope almost perished. In intimate intercourse they make no secret of acknowledging it. The first chief of one of the most important of the tribes dwelt with a peculiar earnestness upon this fact in a final interview between himself and the writer two years since, and his mind was the mind of the many. It is exactly this unfortunate mental status that is working lamentable results upon many of the Indian tribes, while in this attitude a quite ordinary ailment frequently proves fatal. A slight epidemic will carry off great numbers. Children that grow up receive as their most direct inheritance this incubus of hopelessness and are thereby quite incapacitated for aught of successful effort toward their own improvement or the amelioration of the condition of their posterity. The temperament of the Indians has become uniformly melancholic, and those among them, who possess the most of native ability and from whom we should naturally expect the best and largest efforts for good, are the very ones in whom this type of temperament is most emphatically present. I do not remember to have seen this phase of Indian character particularly noticed; but it deserves careful consideration from all who are sincerely interested in their welfare and advancement. Perhaps it would be as well not to inquire too curiously into the course of events that has brought about this special mental attitude in them. The exact truth might not be entirely flattering to our humanitarianism.

Of the deleterious efforts of strong drink and of certain forms of disease communicated to the Indians by the whites it seems scarcely necessary to speak. Their victims are to be numbered by thousands. The sale of liquors to the Indians is now by the wise, but inefficiently administered policy of the government somewhat checked; but it is by no means stopped. One of the most frequent cases before the federal courts, sitting in the vicinity of any Indian reservation is that of the United States *vs.* A B for selling liquor to Indians. By various avenues considerable quantities continue to reach them and its use still operates to their no small detriment. No doubt it is only a very broad euphemism that the stuff thus illegitimately bartered to the Indians may be dignified by the name of liquor; for in more than one instance it has been found by actual test to be a vilest concoction of nauseous and most deadly drugs. The unwholesome effects of such beverage may be readily imagined. Of disease the scrofulous taint has been the most malign. Some medical authorities claim that there is scarcely an Indian within the confines of the United States whose system is not to some extent infected with it. This is certainly an extravagant generalization; but the bare fact of its being ventured is evidence of the general prevalence and insidious virulence of this type of disease. The frequency of various strumous symptoms, and the development of the V-shaped jaw in some tribes; and the alarming mortality among all Indians, of such diseases as affect particularly the glandular system, are momentous indications in the same direction.

Obviously this is a catalogue of adverse influences that might well break the most buoyant and elastic constitution. The Indians have borne up against them with a surprising persistency, but the struggle has been unequal. The magnitude of the Iliad of their woes may be inadequately determined by the fact that in nearly every instance they have lost ground. In the greater number of cases they are still losing ground. The only question now before the friend of the Indian is whether this state of things shall continue; whether the decay shall be suffered to go on practically unhindered till most of the present tribes pass out of existence and become matters of interest solely to the philologist and inquisitive historian.*

Nominally the question was decided years ago. Philanthropists have devised and applied not a few schemes for the saving and civilization of the Indian. But in practice, with here and there a remote exception, the choicest schemes have proven altogether nugatory, if, indeed, not prejudicial. The Indian, as a class, remains still hopeless and helpless. To him, as also to his would-be benefactor, the experience of the past is not remarkably encouraging.

Now, of means possible for the correction of the abuses under which the Indian is losing ground, as I have endeavored to show, there appear to be but two. I. The official, which involves a complete reconstruction of our administrative policy with regard to them. The radical defect of the administration of Indian affairs hitherto has been that in their direction the goverenment has in fact, if not in principle, acted toward them as though they were a temporary burden incident to the acquisition of our newer territory, and its duty was simply to render easy their passage out of existence and not rather to elevate them into the only true existence—that of a man among fellow men. A pupilage, such as their present condition is sometimes complacently termed, lacks the one essential element of a true pupilage: it is not a state of preparation for better things. It is, so far as concerns the Indian, a perpetuity, ending only with his existence.

*I am aware that the statement here offered will receive a prompt rejection from a considerable number of those who have made Indian history and affairs a topic of long and critical investigation. Quite recently there has sprung up a strenuous tendency to go to the other extreme and claim that the Indians are in the main steadily increasing. I believe the truth lies between. There are noteworthy instances of increase; but there are undoubtedly more that show a decrease. I have in this paper purposely refrained from giving lists of statistics, that I might not trespass necessary limits; but I have also carefully refrained from stating aught that might not be verified by copious data.

The control of his interests is erected into a separate bureau which has no organic union nor necessary interdependence with the life and general civil interests of the country. On the contrary, its dealings with the Indians have in not a few instances been so conducted as to bring their interests into apparently direct conflict with the general interests of the community. In fine, the Indian bureau has come to be spoken of and is systematically treated as a most undesirable public burden Instead of there being any well organized and sustained effort to identify the Indian with, or to prepare him for entrance into the body politic as a useful vital force, the general tendency of our present system is to keep him distinctly and emphatically debarred from most of its special privileges and immunities. And not only is this true as related to the direct work of the government with the Indians, but in practice the spirit of its policy has paralyzed nearly every effort from other sources (as charitable societies) in their behalf. The material surroundings and conditions in which they are kept by the government will not admit of nor sustain the Indians' essential moral elevation.

Whether a reorganization of our Indian policy is practicable, as public affairs are now administered, is a grave question; if not, it is a vital weakness. What is required is a system which shall have as its only aim the fitting of the Indian for an early investiture with the full rights of citizenship, and the moment he becomes such, that he comes to realize that he has a rightful place as part of the State, it is not consonant with the laws of human nature that he should continue to decline. To fully discuss this phase of the Indian question would require a volume. My only desire here is to mark it as having been an element in hastening the Indians' decay.

II. This is a most important factor in the consideration of our subject; yet it is one that is difficult of a proper presentation. I do not flatter myself, moreover, that it will at first blush secure any very extended acceptation. The measure here suggested is to be gathered from the last cause assigned for their decay. If it is undeniable that Indian blood has become corrupt by the admixture of a vitiated blood from whatever source, then it is physiologically a most natural method that it might be reinvigorated by the infusion of a new, untainted element, and the problem becomes much simpler if the strain thus engrafted is from a superior stock. Historically it may be accepted as demonstrated that the sturdiest and most persistent types of the human family have often sprung from the union of two differentiated stocks, the one of which presents the highly organized, intense element, while the other affords the heavier physical stamina. Fortunately we have afforded us excellent and abundant illustration of this very phenomenon in Indian history. The old *voyageurs*, the *courieurs des bois*, and even the more unadventurous of the French pioneers of Canada, who chose the prosaic life of farmers, in considerable numbers formed alliances with native women. From this diverse parentage has sprung a large portion of the present population of Canada. Even in the older and more densely settled districts of the Dominion the greater part of the population (excluding recent immigration) still shows evidence of Indian blood; while in the vast Manitoba region the entire body of the inhabitants, farmers and hunters, is of this mixed descent. As to the physical powers and development of the hybrid stock (except where the offspring of vagrant intercourse) the testimony of experience is uniformly favorable. They are a robust, enduring people among their neighbors of pure white blood, with the Indians on the other hand they stand deservedly high. Alexander Henry, in his travels of 120 years ago, reports a Knistenaux chief as saying that the half breeds excelled the pure Indians, both as hunters and warriors. Among the Indian tribes of the West and Northwest it is no unusual thing to-day to meet chieftains and distinguished braves in whom white blood is easily discernible. The excellent characteristics derived from the healthful intermingling of the races are so marked as to warrant the designation of the descendants by eminent authorities as a new and persistent variety of man.

It is just herein, I am persuaded, that we shall find a real and possible solution of the somber problem of the steady diminution of the Indians. The policy of the Canadian government, while the French regime continued, at least indirectly encouraged this blending of the white and red races. Peter Kalm, a most extensive and critical observer, in his narrative does not scruple to commend the system. No doubt it would meet much earlier and ready application with the facile Frenchman than with the more unyielding Saxon; but it evidently is not impossible. That it has occurred, and with beneficial results in case of some of the southern tribes, was sufficiently presented in a paper in a previous number of this journal (November, 1879). In these tribes the preponderance of white blood is more manifest with each succeeding generation, and ultimately it will completely absorb or assimilate the Indian element. The same event would occur with our entire Indian population were the blending once to begin under favorable circumstances. The Indian would disappear, but only in name. Whatever of vital force or quality in him is worthy of conservation would survive and enure to the advantage of the dominant race.

It seems, therefore, that it were become a fit question whether it may not be made a matter of governmental consideration or policy with us to encourage some such system. Certainly the conviction is gaining strength in the minds of most intelligent men who have longest been intimate with the Indian's condition and needs, that such a blending, under suitable limitations, is desirable and for the Indian necessary; without it our Indian policy must remain an anomalous *imperium in imperio*, a prison-house system alien and repugnant to our national instinct and finally ruinous to the Indian.

John B. Dunbar, Deposit, N. Y.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

July 30, 1880.

Professor Vogt has drawn the attention of the National institute of Geneva, to the physiology of writing. It has been demonstrated that certain parts of the brain, situated in the region of the temples, have a predominating influence on the formation of articulated language. It is also well known that the nervous fibers inter-cross in the brain, and in such a manner, that the movements of the left arm are commanded by the right hemisphere, while the movements of the right arm are ordered by the left hemisphere of the brain. Apoplectic attacks and extravasations of blood, are more frequent in the left, than in the right side of the brain. Hence, when the left hemisphere is affected, paralysis and the impossibility to speak result for the members of the right side, while any lesion in the right hemisphere, resulting in paralyzing the left members, generally leaves language intact. Now since a center existsf or language, does one also exist for writing? and since we are accustomed invariably to write with the right hand, the power to do so ought to be paralyzed when the left lobe of the brain becomes attacked. But we can learn not the less to write with the left hand; this raises a general question: Does the manner in which we write depend on physiological necessities created by the structure even of the brain itself? All peoples write with the right hand; how then comes it that the arrangement of the lines and letters be different?

The nations of Eastern Asia write from top downward, and in lines from right to left; Semitics and Europeans place the lines one below the other, but the former shape the letters from right to left centripetally, while the latter do so from left to right and centrifugally. The arrangement of the lines and letters and their formation, are independent of each other; it is the form and size of the letters that constitute individuality. The representation of an object by an image was the origin of writing; the knotted strings in use with the Aztecs was rather an aid-memory than a form of writing; besides, to make a knot on a handkerchief to sharpen the memory, is not uncommon among moderns. The Mexicans have a combination of image and phonetic writing, suggestive of a rebus; the Red Indians when they paint images on skins, differ in little from the races that did the same on rocks. The style of primitive writing depended on the material; on a cornice, the lines were horizontal; vertical on a pillar; circular round a column. Naturally on a pillar the writing would commence from the top downward.

The Arabs and Mussulmans when writing, keep the hand fixed to the same spot, while the other—the left—gently pushes or spins the paper forward, from left to right. The Arabs also prefer to write while standing up, besides, the

Koran enjoins that the right hand ought to remain motionless when writing. Easterns could never have written with the left hand, for that hand has ever ranked as impure. No Turk strokes his beard with the left hand, or employs it to receive food, and to present that to be shaken, ranks in the eyes of westerns as an insult. With a Semitic, every religious action is accomplished with the face turned toward the east; his prayer would be worthless if uttered in any other position; he observes the same rule in writing, so that the light arrives from the south, and he writes from that point to shadeward. Westerns receive the light on the left side, and curiously enough, write also toward the shade. Both are physiologically correct in not writing in full light. A singular fact to note: an individual struck with paralysis, experiences ever afterward an inability to pronounce certain letters, *f*, *l*, *r*, for example; the correlation will extend to the incapacity to write these letters, a simple crook is at most all that can represent them. Naturally, as observed, the right hand predominates; this was the case in the time of Homer's heroes, and was so with their ancestors; and modern man writes easily, and as rapidly, as a musician's fingers move unconsciously, because the images or letters are stored in the left hemisphere of the brain. Left-handed penmanship is only right-hand writing topsy-turvy; this explains the eccentricity of Leonard de Vinci's explanations of his designs, and that puzzle so many persons; he wrote upside down at an early age, and continued the freak when residing in France. Many lithographers at present write on the stone with the left hand and draw with the right.

Professor Vogt concludes, that the position of the lines in writing and reciprocal arrangement of the letters, depend on no physiological necessity.

M. Hēbert has been studying what was formerly the geologic condition of the Straits of Dover, and concludes that during the first phase the tertiary period, a part of the Straits was covered by the German ocean, which communicated with the basin of Paris by the plains of Artois, while it also extended to Belgium, Westphalia and Hanover. He fixes the opening of the Straits, during the quaternary period.

Professor Daubrée claims for Descartes, the honor of being one of the creators of cosmology and geology, he had been replaced by Newton and Voltaire. Before Laplace, Descartes cousidered all celestial phenomena as simple deductions from the laws of the mechanics; he proclaimed the physical unity of the universe, before the spectroscope had revealed the chemical composition of the most distant worlds, and that the earth and the heavens are made of the same matter. Heat, according to Descartes, played a rôle capital in the formation of our globe, which was at one time a star, differing in nothing from the sun, save in being smaller, and that the dislocations in celestial vault have been produced by coolings and contractions. The idea that igneous, or crystallized rocks were at one time stratified till coming in contact with the internal heat of the globe, they became volcanic, has been abandoned since the explorations of Humboldt in the Andes, and of De Buch in Norway; the latter found crystalline rocks lying over stratifications, the same in the Tyrol and in the Canaries—proofs of the subterranean activity of the earth. Cordier, also concluded from the increasing temperature of mines with their depths that the mass of the globe was still in a fluid state. M. Elie de Baumont has based his vast system on this crust of the globe contracting by cooling. He astonished scientists also by asserting that the oldest mountains, were not the highest, and that little hills in Britany and Wales, were older than the Alps and the Andes. The classification zoölogic and the classification by systems of dislocations and upheavings, to-day march side by side. Professor Daubrée points out that by no means can feldspar or analogous silicate rocks be formed independent of heat, that the fissures in the rocks filled with metals, have been in intimate relationship with the internal regions of the globe

M. Perroncioto has made some further researches as to the cause of the anemia which affects the workmen in the St. Gothard tunnel. He found the patients were invariably suffering from quantities of worms, like small eels, whose presence sufficiently explained the malady. The same diagnosis was observed in the case of the men who bored the Frejus tunnel.

Teeth have a very intimate connection with health; bad teeth imply a bad stomach, and a stomach which functions badly contributes to caries and the loss of the teeth. From the very earliest history, the preservation of the teeth occupied attention. Homer, Hesiod, Euripides, etc., constantly allude to the subject. In the law of the Twelve Tables, it was prohibited to bury the dead with gold, except when that metal served to bind the teeth. Cascellius, the famous dentist at Rome, left, when dying, a fortune greater than that of a pro-consul. Tooth preservatives or powders, were also in great request in ancient Greece. Young ladies ever had a portion of myrtle, the shrub sacred to Venus, in their mouths, and St. Clement blamed the ladies of his day for their coming to the temple with their mouths full of the drug mastic. The adult has sixteen teeth in each jaw, the child but ten, till seven years of age. A tooth consists of the crown which extends outside the gum, the neck, which is covered by the gum, and the root, which occupies the socket. The tooth is hollow, and filled with a pulp; closed toward the crown, but open at the roots to allow the nerves and blood vessels to ramify. Three different tissues compose the teeth: the ivory or dentine, which exists at the root, as well as at the crown, and forms the principal part, it is not bone, as many think, though it has the same chemical composition, no vessel penetrates it, and it has neither medullar sap, nor pores, it consists of of layers, one over the other, and hardened even at the moment of formation. Next, the enamel, which covers the crown of the tooth, and that resembles not a little porcelain, the shade varying with the temperament of each individual. It is so hard as to resemble blue steel, it marks the best files, and will strike fire with steel, like a flint; third, the cement, which covers the tooth, and thicker at the root than at the neck. The teeth live and grow by means of their pulp, a matter extremely sensitive, and when inflamed, very painful, in consequence of the impossibility to augment its volume, being narrowed in on all sides by the ivory. It is to the sensibility of this pulp, that we immediately feel the least differences between heat and cold, and the slightest shades in the food masticated. The incisors have only a crown and a root, and constantly grow, as in the case of rabbits and other gnawing animals; they cut the food, while the canine teeth tear it. The "wisdom tooth" has roots and a crown less developed; its form varies, and it appears at no fixed age; when it has no room to develop, grave results may ensue. When, through age, the teeth disappear, the form of the jaw bones alter, and impart a change to the physiognomy, the lower jaw bone inclines backward, as with infants, and the chin becomes pointed. Teeth grow irregularly from various causes, and the best period to correct the defect is between ten and fifteen years of age. For persons who have acid stomachs, and which thus favor the destruction of the enamel, alkaline drinks ought to be patronized, and alkaline powder, containing a little magnesia, employed. Caries can be either dry or humid—the former, often suddenly stops of its own accord, but commences by a black spot, and marked sensibility to heat and cold. When the disease eats into the pulp, the tooth ache appears in a most violent form. When caries appears, food should not be partaken of when too hot or too cold; brushes rather soft than hard, ought to be employed; alkaline powders are excellent for combating the acid of the saliva—one of the chief causes of caries—as stringent preparations fortify the gums. When the teeth are lost, they ought to be replaced, not only in the interest of pronunciation, but in that of digestion, for on the efficacy of the latter a prolongation of our days depends.

There are numerous thermal stations, spas in Europe: England has eight, Germany seventy-two and France 116. What is chiefly to be kept in view, is not the quantity of mineral matters in solution, but their quality. There is no classification for natural mineral waters. Their production is one of the most interesting problems of geology; the mineralization is effected under the influence of heat and pressure; is in connection with the nature of the soil, and is associated with chemical reactions as complicated as they are obscure. There is much difference in composition of springs in point of yield, temperature and richness of solution, and they have a relationship with barometrical oscillations and earthquakes. The Lisbon earthquake affected all the thermal springs of Europe. However, the best known mineral waters have a very stable and ancient origin.

THE SIXTH SENSE.

Dr. Hughes Bennett, Professor in Edinburgh University, lately read a paper before the British Association of Science, wherein he announced that the tendency of modern physiology was to ascribe to man a sixth sense. If there be placed before a man two small tubes, the one of lead, the other of wood, both gilded over so as to look exactly alike, and both of the same temperature, not one of the five senses could tell the man which is lead and which is wood. He could tel this only by lifting them, and this sense of weight was likely to be recognized as the sixth sense.—*Scientific American.*

BOOK NOTICES

THE SKIN IN HEALTH AND DISEASE: By L. D. Bulkley, M. D., Philadelphia: Presley Blakiston, 1880: p. 148, 12 mo., 50 cents.

This is number ten of the American Health Primers, which have proved so timely and so successful. The author, who is attending physician at the New York hospital, writes with experience and consequently with a ready pen; dividing his subject into but four chapters, which, however, cover the whole ground as fully and completely as could be asked in a merely popular treatise. In the first chapter he undertakes to combat certain popular prejudices in regard to diseases of the skin by briefly describing the anatomy and physiology of the skin. The second is devoted to directions in regard to the care of the skin in health and for the prevention of disease, and this is the most important of the whole. The third takes up the diseases to which the skin is liable, their recognition and home treatment. The last furnishes directions for diet, hygiene and mode of life, which will aid the physicians in their cure. The author's remarks upon soaps will certainly surprise most readers and should serve to put them upon their guard against the numerous "medicated," "soothing" and "curative" nostrums, which are usually manufactured of the cheapest and most objectionable ingredients and are far more likely to communicate disease than to remove it. It is abundantly illustrated and handsomely printed.

FELTER'S ELEMENTS OF ARITHMETIC: By S. A. Felter, A. M., and S. A. Farrand, Ph. D., New York. Charles Scribner's Sons, 1880, p. 154, 12 mo. Cloth, 30 cents.

Felter's Arithmetics have been used for years in the New York schools and have received the highest commendations from the principals of many of them. Their advantages seem to be the ignoring of theoretical discussions, technical definitions and rules, and the furnishing of a larger variety of practical examples and a closer and improved grading, while the illustrations are marvelously fine for a school book. The charm of the illustrations and the easy and simple steps of the ascent, from the notation one book, two boys, three ducks, four hens and five birds, all depicted in the most artistic manner, to the handling of fractions also illustrated in an equally attractive way, must necessarily beguile the most wary boy into an interested examination and study of the subject before he knows it. The series comprises the above and The New Intermediate, The Advanced and the Complete Arithmetics, all by the same authors and all spoken of, by those who have used them, in the highest terms.

RECORD OF THE PROGRESS OF ASTRONOMY FOR 1879: By J. L. E. Dreyer, M. A., Dublin, Ireland.

This is a sketch of the principal astronomical events of the year 1879, and an account of the more important and interesting investigations that were made in that year. It is intended as a continuation of the work of Professor Holden, of the U. S. Naval Observatory, who has for several years prepared such a paper for the Annual Record of Science and Industry (now discontinued). In this account of the world's progress in astronomical work it is gratifying to notice that the labors and investigations of the observers of the United States occupy a prominent position, and that the names of such western observers as Pritchett, of Missouri, Stone, of Cincinnati, Burnham, of Chicago, and Watson, of Ann Arbor, are mentioned in connection with services of a most valuable character to astronomical science.

THE DATA OF ETHICS: By Herbert Spencer: J. Fitzgerald & Co., 1880, Paper, 15 cents.

This is number 9, volume I, of the Humboldt Library, those preceding it being Light Science for Leisure Hours, by Prof. R. A. Proctor; Forms of Water, by Prof. Jno. Tyndall; Physics and Politics, by Walter Bagehot; Man's Place in Nature, by Prof. T. H. Huxley; Education: Intellectual, Moral and Physical, by Herbert Spencer; Town Geology, by Rev. Chas. Kingsley; Conservation of Energy, by Prof. Balfour Stewart; The Study of Languages, by C. Marcel

Thus it will be seen that for $1.35 one can procure nine first class, standard works by the best writers of the present day, printed in fair type on good paper, while, by subscribing by the year, twenty-four such works can be had for $3.00 per annum.

QUARTERLY REPORT OF THE KANSAS STATE BOARD OF AGRICULTURE, JUNE 30, 1880: J. K. Hudson, Secretary: pp. 119 Octavo.

This valuable work contains, as usual, statistics relative to population, acreage of important crops, railroads, public lands, condition of crops, farm animals, meteorology data, etc., together with the Summer and Fall treatment of orchards and vineyards, the Growing of sorghum cane, and the Habits and transformations of the web worm, the last by Prof. E. A. Popenoe, of the State Agricultural College. This Report is an excellent number, creditable alike to the State and to Major Hudson, the new Secretary of the Board of Agriculture.

CIRCULARS OF INFORMATION OF THE BUREAU OF EDUCATION, NO. 2, 1880: Hon. John Eaton, Commissioner: Govt. Printing Office, 1880.

This so-called circular comprises 111 pages and is a Report of the proceedings of the Department of Superintendence of the National Education Association, at the meeting at Washington, Feb. 18–20, 1880.

This meeting was attended by about sixty-five of the Superintendents of State Boards of Education, Public Schools, Boards and Principals of Seminaries, etc., from all portions of the United States.

Papers upon appropriate subjects were read by Prof. S. A. Butterfield, President Gilman, of Johns Hopkins Union; Hon. C. D. Randall, W. T. Harris, LL. D., and several others, besides discussions of kindred topics, in which most of the members joined.

These circulars contain valuable matter for teachers at all times, and this particular number is especially rich in useful and entertaining articles and suggestions.

SCIENTIFIC MISCELLANY.

MANUFACTURE OF LINEN.

Although the natural appearance of wool might first have suggested its use as a textile and woven material, there is no historic evidence that woolen cloth antedated that of linen. The manufacture of linen dates from the earliest written records. It was well known in the time of Herodotus, and the Egyptian mummies are swathed in linen cloth. With the Egyptians, linen appears to have borne a sacred character, as their priests were forbidden to enter the temples clothed in other than linen garments and their dead were always shrouded in it. In later times linen cloth appears to have been a manufacture very generally practiced among civilized peoples.

Probably because of the superior facility with which cotton fiber can be prepared for spinning and weaving, the manufacture of linen in this country does not seem to have attained the proportions to which its actual value entitles it. The extensive application of machinery to the manufacture of linen is of a comparatively recent date, and even now much of the Irish linen is of hand make, from the pulling of the flax to the finish of the cloth. Massachusetts appears to have led in the linen manufacture in this country. Previons to 1640 the people of this colony imported from England most of their clothing and all of the finer sort; but in that year the Assembly decreed that:

"The Court taking into serious Consideration the absolute Necessity for the Raising of the Manufacture of Linnen cloths, doth declare that it is the Intent of this Court that there shall be an Order settled about it, and therefore doth require the Magistrates and Deputies of the several Towns to acquaint the townsmen therewith, and to make Enquiry what seed is in every town, what Men and Wimmen are skillful in the braking, spinning and weaving, what means for the providing of Wheels; and to consider with those skillful in that manufacture, and what course may be taken for teaching the boys and girls in all towns the spinning of the yarn, and to return to the next Court their several and joint advice about this thing. The like consideration to be had for the spinning and weaving of Cotton Wool."

The description of cloth to which this order applies appears to have been a mixture of cotton and linen, or linen and wool, known as "linsey-woolsey." A subsequent order offered "a bounty of three-pence on every shilling's worth of linen, woolen and cotton cloth, according to its valation, for incouragement of the manufacture." New England is also entitled to the honor of the first linen factory, which was established in the year 1737 in "Long Acre,"—Tremont street, Boston. In 1662 the Assembly of Virginia enacted laws for the promotion of the industry of cloth making. Two pounds of tobacco were offered as a bounty for every pound of flax, or hemp, prepared for the spindle, three pounds for every yard of linen cloth a yard wide, and five pounds for every yard of woolen cloth. Every titheable person was required, under a penalty of fifty pounds of tobacco, to produce yearly two pounds of dressed flax or hemp. Flax seed was imported from England and distributed to each county. Denton, in 1670, says of the women of New Netherlands: "Every one make their own linen and a great part of their woolen cloth for their ordinary wearing." In New Jersey, in 1867, Quakers from Yorkshire and London made linen cloth, and in Pennsylvania, in 1693, and in Delaware, at about the same time, one of the principal employments of women was the spinning and weaving of linen, and in New Hampshire, in 1719, Scotch-Irish carried on the business quite extensively.

The manufacture is growing in this country, but not with such rapidity as many other industries. The census of 1870 reports 90 establishments for the manfactures of flax, but how many are devoted to the making of linen cloth does not appear. Of these 90 no less than 46 are in New York. (The census of 1860 showed only ten in New York and Massachusetts.) Ohio, in 1870, had 27 establishments, and the remainder were scattered in five or six other States. The entire number of hands employed in 1870 was 765, the capital invested $524,701, and the annual value of products $815,010. Some interesting facts will be added to the above by the results of the pending census, and it is quite certain they will be much more reliable as data than some which have heretofore been published under sanction of the government.—*Boston Journal of Commerce.*

ADVICE FOR SUMMER WORK.

BY PROFESSOR BURT G. WILDER, M. D.

Notwithstanding the number of "Summer Schools of Science" to be in operation this season, many teachers are likely to pass the vacation at a distance from the facilities afforded by organized laboratories. How shall they employ their time?

Doubtless they all need rest, and in most cases at least a fortnight should elapse before any intellectual labor is undertaken. An equal period of repose may well occur just before the renewal of teaching in the Fall. But the teacher who hopes to make his instruction each year more thorough and successful than the last, will be pretty sure to spend the remaining month or two in the search of help from books, and, while regretting the vagueness of the information thus obtained, may seldom think of making it more real by personal observation.

Now it is true that in some branches of science this may require appliances not readily obtained. This is the case with Chemistry and Physics, and some parts of Natural History. But Botany and Entomology may be pursued under almost any circumstances, and I venture to suggest that at least one kind of *anatomical* work may be carried on with but a slight amount of apparatus.

Obviously, the summer is not the most favorable time for study of the viscera, while anatomical details respecting the muscles, vessels and nerves are not especially required for ordinary instruction. But the *brain* is not only the organ least satisfactorily treated in the text books, but at the same time the one concerning which the most should be known, from the double standpoint of physiology and psychology.

But how can the teacher procure brains, and how shall he preserve them when obtained?

The question is a perfectly natural one in view of the prevailing impression that the cerebral structure is to be learned from the human brain alone. So far from correct is this idea, that from a single animal brain, perfectly fresh or well preserved, more may be gained than the average medical student learns from the human brains usually examined in the dissecting-room.

This is due to the fact that, excepting the absence of the occipital lobes of the hemispheres, the brains of the cat, the dog, the rabbit and the sheep present nearly all of the structural features of the human brain, while their smaller size and greater accessibility better adapt them for manipulation and for the preservation of the numerous specimens which are needed to display all parts of the organ.

Of the animals above named the cat seems to be the most favorable subject. It is always and everywhere obtainable; the brain is larger than that of the rabbit, and more easily extracted than those of the sheep and most dogs.

Some features of the brain, as the coloration of different parts, and especially the relation of the gray and white substances, are better seen upon fresh specimens; but the beginner will do well to examine hardened brains first, so as to become familiar with the form and relative position of the parts, and with their names.

Among the instruments needed for the removal and dissection of the brain the most essential are a very sharp knife, and a pair of "wire-nippers" with the blades set at a slight angle with the handles.

As an aid to the study of the brain any work upon Human Anatomy will be found useful. The best are those of "Quain" and "Gray." Descriptions, without figures, of the brains of the sheep, and of the dog and rabbit, are given in the little works of Morrell and Foster and Langley. With some modification these apply to the brain of the cat.

Finally, it is hardly necessary to urge that outline drawings be made of the brain as a whole, and of its parts as exposed by dissection. If this is done, by the end of the summer the teacher will have become better able to appreciate the peculiarities of the human brain when one comes in his way, and will have laid a substantial foundation for the physiological and psychological instruction which he may be called upon to impart.—*Science.*

THE PROPAGATION OF OYSTERS.

At the recent meeting in this city of the American Fish Cultural Association, a paper was read on the propagation of the oyster, by Dr. W. J. Brook, of the Johns Hopkins University. The manner in which this propagation takes place had never before, he said, been thoroughly understood. Through studies made by him last summer, however, great light was thrown on the subject. He found that the American oysters do not breed their young in the shell, as had been supposed, and consequently the eggs can be impregnated artificially. An average oyster contains from six to nine million eggs, and one of large size may contain fifty millions. The plan pursued by him in fertilizing these eggs was to chop the male and female oysters up together; thus the fluids are mixed and the impregnation is made complete. The process of development immediately begins, and goes on so rapidly that a change may be noted every fifteen seconds. In a very few hours the embryo is sufficiently formed to swim in the water. The shells at first are very small, and are not adjacent to each other. They grow very rapidly, closing down over the sides, and finally unite and form the hinge. In the short space of twenty-four hours the young oyster is able to take food, and from three days to a week it attains perfect form. During its early life it is a swimming animal. Tne oyster is able to reproduce its species at the end of a year's growth, and it is marketable at the age of three years.—*Scientific American.*

THE ANGLO-AMERICAN CATTLE COMPANY.

Notwithstanding the rapid development of the trade in dead meat and cattle between this country and America it is probable that the traffic is only in its infancy. To carry on the breeding and rearing of stock in the plains of the far West, in a systematic manner, the Anglo-American Company was established abont a year ago, and it has been working with much energy in thus utilizing the resources of that great expanse of magnificent grazing country. Already the company's manager, Mr. Groom, has secured about 9000 head of fine cattle in Texas at an average of 27s. or say 30s. each; and these are being steadily driven in three great herds, containing something over 3000 heads apiece, towards a point on the great railway system stretching from the Atlantic to the Pacific, where they will be worth at a moderate computation twenty dollars or £4 per head. According to last reports all three herds had safely passed through the more enclosed and most difficult part of their long journey, and for the rest of the way there was abundance of pasture and water. The land upon which the company's cattle are and will be fed belongs to the United States Government, who allow and encourage it to be occupied in the manner proposed by the company, rent free. The rich prairie on either side of Goose Creek in Wyoming, which is at a convenient distance from the Union Pacific Railroad, has been selected as being the most suitable for the purpose. It is in the heart of the country upon which the buffalo has thriven from time immemorial, and produces sufficient feed to keep cattle fat all the year round. In these districts cattle breeding has up to the present time been conducted by individuals of very limited means, who have nevertheless often secured ample fortunes. The capital of the company, which is incorporated under the Limited Liability Act, is fixed at £70,000 in shares of £20 each, and the unalloted balance is now for a limited time offered at par.—*Iron.*

RUSSIA IN GREECE.

The Russian government recognizing the opportunities presented by the excavations and explorations, now taking place in Greece, has resolved to send some specialists to the very spot of these discoveries. It is also proposed to organize, in a short time, in Greece, a Russian Archæological Institute, in imitation of those of Germany and France. For this purpose, Prof. Skolow has been sent to Athens for four months, and Mr. Ernstaedt, licentiate of the University of St. Petersburg, and Mr. Latyschew, master of the gymnasium at Vilna, have been sent for two years.

BUILDING WITH TEMPERED GLASS.

We have lately entertained our readers about ties of tempered glass for railroads, obtained by Siemen's method. A new application of this method has been pointed out to us which would have appeared incredible at the time, when glass was only known in its primitive condition, as a crystalline product, with sharp, broken edges, yet fragile and unresisting to shocks and pressure. Tempered glass can be obtained in great pieces, gifted with a power of resistance, which its specific lightness, compared with heavy metals, would not have given the least presumption. It can now be employed, notably in carpentry, for posts, joists, ties and buttresses. It combines the advantages of strength and of incorruptibility in contact with all atmospheric agents, as well as with chemical factors, and consequently, is of perpetual duration, and join to these advantages the smallness of the price of acquisition. This material is now as cheap as iron of the same weight, and as a large sale is counted on, it will not be long until the reduction of price will be below the cost of wood. No doubt many industries will profit from this new progress in the fabrication of glass, and it will be greatly appreciated in the household. One will see the time when the metals and wood will be replaced by glass, in a great number of implements, utensils, and objects of diverse nature, such as stop-cocks, gutter spouts, buckets, and even barrels.—*L' Technologiste.* J. F.

AGUE A POISON.

T. L. LEWIS, BOLIVAR, MO.

A French chemist, M. P. Bolestra, in a communication to the French Acad-my, some time ago, offered the following theory in regard to ague. In water undergoing putrefaction he found a granular microphyte, resembling the *Cactus Peruvianus*. It grows on the surface of the water, and in its young state looks like oil, and is ornamented with rainbow tints. In water of low temperature, or that containing but little vegetable matter, it grows but slowly, but under the the direct solar rays, mixed with decomposing vegetation, it develops rapidly and continually disengages small gas bubbles. It is always accompanied with great numbers of small spores, $\frac{1}{1000}$ of a millimetre in diameter, and sporangia or vesicles containing spores from $\frac{2}{100}$ to $\frac{8}{100}$ of a millimetre in diameter, and of a very peculiar form. These spores are of a greenish yellow, quite transparent, and are often detected in marshy atmosphere. He claims to have contracted ague three times from these spores, which he claims to constitute *ague poison.* He says that "a few drops of arsenious acid, sulphate of soda, or, still better, neutral sulphate of quinine, stops its vegetation at the surface of the water, the spores become thin and transparent, and the sporangia alter so that they would not be recognized. These changes may be seen under the microscope."

HYGIENE.

WHAT TO DO IN EMERGENCIES.

From two of the valuable papers on "Domestic Nursing," by Miss E. R. Scovil, of the Massachusetts General Hospital in this city, we cull and condense the following extracts for the benefit of our non-professional readers:—

In very severe cases of burns or scalds the nervous system is so prostrated by the shock that there is often less suffering felt than when the injury is slighter. The pulse will be small and quick, and a stimulant should be administered without waiting for the doctor. A teaspoonful of raw brandy, or a tablespoonful in an equal quantity of water, may be given.

The whole theory of dressing is to exclude the air. The more effectually this is done the greater will be the relief afforded. When only a small surface is injured, an artificial skin may by formed with flexible collodion; or if that is not at hand common mucilage or gum arabic dissolved in warm water will answer. As one layer dries another should be painted over it.

An excellent remedy for burns and scalds is a mixture of lime-water and sweet or linseed oil in equal parts. Another excellent one is bicarbonate of soda. The common kind used for cooking purposes may be employed. A thick layer should be spread over the part and cover with a light wet bandage, keeping it moist and renewing it when necessary.

When the clothing takes fire it is well if the victim have presence of mind to stand perfectly still. Motion fans the flames and causes it to burn more quickly. He may throw himself on the floor and roll over and over, but never move from place to place seeking help. A woolen shawl, piece of carpet, or rug may be wrapped tightly around the person, not covering the face, and if there is time to wet it so much the better, but there is not an instant to lose, particularly if the clothes is of cotton. The great object is to prevent the flames from getting down the throat and the chest from being burned.

In a severe cut on the finger, when the flow of blood renders dressing it a matter of difficulty, it may be checked by tying a string tightly around the base of the finger. It must then be washed in cold water, and the cut can be dressed at leisure with diachylon or court plaster, and the string removed.

Bleeding from the nose may be stopped by lying flat on the back, with the head raised and the hands held above it. The nose must be covered with a cloth filled with pounded ice, or wrung out of ice water. The head should never be held over a basin, as the position encourages bleeding. The blood may be received in a wet sponge.

When any one coughs or spits up blood the first thought is that it must be from the lungs. A slight knowledge of the characteristics of the bood from different parts that may come through the mouth will sometimes save much needless anxiety. Blood from the lungs is always brighter red in color, because it has just been purified by contact with the air. It is frothy, mixed with mucus, in small quantity, and is usually coughed up. Blood from the stomach is dark red, almost black, it is mixed with particles of food, comes in large quantities, and is vomited. Blood from the mouth and gums is of a red color, and usually mixed with saliva. Unless it has first been swallowed, it is not vomited or coughed up.

In hæmorrhage from the lungs the head and shoulders must be raised. Some physicians recommend a tablespoonful of table salt to be given in a tumbler of water. It is always safe to give cracked ice. Bleeding from the stomach may be checked by the application of a mustard plaster over the stomach. Cracked ice should be given and the doctor sent for.

In bleeding from wounds or recent amputation there are three things that may be done:—

First, press the finger or hand over the bleeding point:

Second, press on the main artery supplying the wound; or, if this cannot be found, apply a bandage as tightly as possible above the wound. An excellent tourinquet may be improvised by knotting a handkerchief closely around the limb, thrusting a short stick through it, and twisting it tight. The blood from an artery is bright red and comes in spurts with each beat of the heart, while that from the veins is a dark purplish color and flows in a steady stream. When the bleeding is from an artery the pressure should be applied between the wound and the heart, when from a vein the limb must be compressed beyond the wound.

Third, raise the part above the rest of the body, that the blood may drain out of it, and support it on pillows. It should be bathed in ice water and have ice wrapped in cotton cloths laid on it. If faintness ensues the sufferer should not be immediately roused, as this is nature's remedy and acts by lessening the force and activity of the circulation. A physician should be called in as soon as possible.

When poison has been swallowed the first thing to be done is to get it out of the stomach as soon as possible, before it has been absorbed into the system. As a stomach-pump does not form part of the furniture of an ordinary house, this must be effected by means of an emetic. Should none other be accessible, stir a tablespoonful of mustard into a tumbler of warm water, and give one-fourth of it at a time, following each dose with a cup of warm water; table salt will do as well, using as much as the water will dissolve. When vomiting is over, the whites of two eggs stirred in a tumbler of water may be given, and as much warm milk as can be taken.—*Boston Journal of Chemistry.*

NECROLOGY.

GENERAL ALBERT J. MYER, U. S. A.

General Albert J. Myer, Chief Signal Officer U. S. A., died of heart disease at Buffalo, N. Y., on the 24th ult. leaving a wife and six children.

He was best known as a meterologist and the organizer of the United States and International Storm Signal Service; but this was by no means his only public work. He entered the army as an assistant surgeon, September 18, 1854, having but three years before gratuated in medicine, at the University of Buffalo, N. Y. From 1858 to 1860 he was on special duty in the signal service. Under the act of Congress passed March 3d, 1863, he was made Colonel and Chief Signal Officer, after having served with distinction under Generals McClellan, Butler and others, and was subsequently brevetted as Brigadier General for "distinguished services in organizing, instructing and commanding the signal corps of the army, and for its especial service October 5th, 1864." In 1864 the signal corps of the army comprised over 1,500 officers and men, under his command, which force, at the close of the war, was reduced to about 150 members.

Early in 1870 Hon. H. E. Paine, of Wisconsin, introduced a bill in Congress providing for the establishment of a system of storm signals, based upon meteorological observations by the signal corps and officers of the army, and General Myer was placed in charge of the work. To this genial task he devoted himself with great ardor and success, establishing for the first time in meteorology a broad system of simultaneous reports of the weather, founded upon simultaneous observations taken all over the country at the same moment of actual (not local) time, and embodied upon weather maps issued thrice daily from the Signal office at Washington, as well as telegraphed to all prominent points for the information and warning of navigators, farmers and others.

The importance of this service was recognized by his being assigned to duty according to his commission as Brevet Brigadier-General in June, 1871. In March, 1873, Congress made it the further duty of the signal corps to establish signal sections at light-houses, life-saving stations, etc., and to connect them by telegraph with such points as were necessary to accomplish the objects in view, thus enabling General Myer still further to extend his system of simultaneous observations of the weather. The last Congress made him a full Brigadier General

In September, 1873, at the International Meteorological Congress, at Vienna, he was the representative of the United States and there proposed a system of uniform observations, with a view to their daily exchange, to be taken and recorded simultaneously at as many stations as practicable all over the world. This proposition was adopted and the observations were commenced at once with semi-monthly exchanges. In 1875 the publication of a daily International Bulletin was commenced, and in 1878 that of a daily International Weather Map, with the most valuable results. The gradual extension of this system of International observations to every portion of the globe, so as to permit the announcement of approaching storms and changes for periods longer in advance than have been heretofore practicable, was the cherished desire of General Myer's heart; but it was not to be so. He died at the early age of fifty-two years; fortunately leaving his work in the hands of experienced and zealous followers, who will undoubtedly carry out in full his intentions and aims.

CARL PETERSON.

The death, at the age of sixty-seven years, of the Danish explorer, Carl Peterson who had made so many voyages to the North Pole, has been announced at Copenhagen. From 1850 to 1851 he took part in the English expedition of Capt. Parry, in seach of the survivors of the Franklin Expedition. From 1853 to 1855 he accompanied Dr. Kane's Expedition, of which, he was one of the few survivors. From 1857 to 1859 he was with Sir Leopold McClintock, whose expedition brought back many relics of the Franklin Expedition. Finally, he took part in the voyage of Spitzberg on the *Irnite*, during which, he was accompanied by Dr. Nordenskjold.

EDITORIAL NOTES.

THE first meeting of the fall and winter session of the Kansas City Academy of Science, will be held at its rooms on Tuesday evening, September 28th, and on the last Tuesday of each month thereafter, until the next summer vacation.

THE rainstorm of Sunday, Aug. 15, would have passed for a very respectable "cloud-burst" or "water spout" if it had occurred in the Rocky Mountains. Between 3:15 and 4:50 p. m. two inches of water fell, as observed by Mr. Kenmuir; which, if it had fallen upon precipitous mountain sides, would have filled any ordinary valley or cañon in a brief space of time, and to a depth that would have done a great deal of damage.

THERE was frost in the interior river counties of New York on Aug. 15th. At Stamford, Delaware county, ice formed. The temperature there at 6 a. m. was thirty-two degrees. A dispatch from Rondout says tender vegetation was killed by the frost on that night. The growing crops of corn and buckwheat are somewhat injured. A stage driver reported light snow in Stony Cleave, Ulster county. At the same time the mercury here and in this vicinity stood at 80° at 7 a. m., 93° at 2 p. m. and 75° at 10 p. m.

A SOCIETY has been formed in England with the object of making systematic excavations in ancient Egypt. Many learned Egyptologists have promised it their support. Miss Edwards proposes to deliver a series of lectures, in this country, for the purpose of procuring funds for the enterprise.

PROFESSOR Von Geert, already distinguished for his scientific explorations in Peru and other countries of South America, left Panama June 10th, for Guatemala, where he proposes to study the botany of that country, and to make collections of new specimens, which he hopes to find in the northeast part of that Republic, which is, as yet, scarcely known from a practical standpoint.

ON the evening of August 12th at about 9 o'clock we witnessed a very fine auroral display, which was also observed throughout the northern and eastern States.

WE are indebted to Dr. John Rae, of London, England, for a copy of his sketch of the life and labors of the great Arctic navigator, Nordenskjold. We have read nothing so interesting and complete, and hope to give it to our readers at an early date.

THE number of meteors observed here in the nights of August 10th and 11th, was quite as large as usual, in some parts of the heavens numbering five or six to the minute for several hours on both nights.

ITEMS FROM THE PERIODICALS.

PROMINENT among the articles in the London *Monthly Journal of Science*, is a series of letters by Dr. C. K. Akin, pointing out the proper course for the Royal Society and other scientific associations to pursue, to render their work more effective and valuable; on the changes needed in the system of teaching at the British Universities to cause them to become more successful in fostering and advancing the growth of science in England; and on the kind of scientific literature, periodic and nonperiodic, that is required to place before the students of science the results of experiments by their leaders and teachers. It also contains an article on The Constitution of the Earth, by Robert Ward, a Defense of Vivisection and a continuation of Prof. Tyndall's Lecture on Water and Air, etc.

THE *Mining Record* gives an interesting statement of an excursion made to Santa Fe by Mr. Vandermeer. In the course of his trip, he visited the Indian village of Tosoque, the inhabitants of which claim to have descended directly from the Aztecs. They are more industrious and intelligent than the Red Skins. They inhabit houses of two stories, and have no communication with the ground floor except by ladders. In case of alarm or surprise the ladder is drawn up into the second story, and the house thereby converted into a fortress. Each house has three or four rooms, and the village has altogether about 200 inhabitants.

THE *Columbia Sentinel* reports that Mr. R. B. Gans, a farmer of Boone county, has constructed several small telescopes, which are excellent instruments, and that he is now working upon one of seven inches aperture. He has also invented and constructed a machine for grinding the glasses which is superior to any now in use. One of his telescopes is now on exhibition at the Missouri University, and is pronounced by Prof. Ficklin and others to be a perfect instrument. His next effort will be upon one of 16½ inches diameter and 20 feet focal length. The wonder in this case is that Mr. Gans has never had any training whatever in this direction, but is an amateur in the strictest sense.

BOSTON has at least two good periodicals in their respective departments, the *Journal of Commerce* and the *Journal of Chemistry*. Both are ably edited, widely read and perfectly reliable. We frequently take occasion to borrow articles from them and always feel when we do so that we are giving our readers valuable and readable matter.

JUDGING from accounts in the *Engineering and Mining Journal*, the absence of all of the precious metals in any one of the States or Territories would seem to be the exception to a general rule. Gold mines in New England, New York and New Jersey, Virginia and North Carolina are announced, (also in Nova Scotia,) while silver mines are spoken of in Missouri and Arkansas, as well as both kinds all through the western mountains, California and Arizona. Truly, the outlook for the prosperity of the United States never was so promising.

THE *Journal of the Franklin Institute* has its usual quota of interesting scientific articles. Among others we note one on the Limitations of the Steam Engine, by Prof. Wm. Dennis Marks, of the University of Pennsylvania, in which the author remarks that so far as evaporation is concerned the perfect boiler has probably been attained, and that the utilization of the steam after it reaches the engine is the principal point to be looked after. Next come concentration of power in a small space and economy of steam. Then the prevention of condensation by cooling, which he proposes to accomplish by diminishing the condensation surface and increasing the number of the strokes of the piston; also the reduction of the diameters of the frictional bearings to their lowest practical size and the attainment of high and regular speed. The article is an interesting one but it cannot be condensed and we only give the above points, to stimulate the reader of mechanical turn to procure and read it in full.

THE *Phrenological Journal*, for September, contains analytical articles upon Hancock and English; Studies in Comparative Phrenology; Notes on the Psychology and Patholo of the brain; Relation of food to morals; Notes on science, agriculture, Editorial items, etc.

THE essay upon the History of the word Chemistry, by Dr. R. Augus Smith, F. R. S., before the Manchester Literary and Philosophical Society, March 23d, an abstract of which is given in the *Chemical News*, contains a good deal of new matter, showing a vast deal of research and study into the history of the Hebrews, Assyrians, Egyptians and Greeks, and furnishing results interesting not only to the chemist but also to the student of ancient languages.

In the September *Atlantic* we find the concluding chapters of "The Stillwater Tragedy," one of the most vigorous, ingenious and delightful novels Mr. Aldrich has yet written. Richard Grant White describes a visit to Oxford and Cambridge, which will have great interest for many readers. The Washington Reminiscences this time relate to the short-lived Harrison Administration. There are two good political articles—one on the "Progress of the Presidential Canvass," the other on the important subject of the "Political Responsibility of the Individual," by R. R. Bowker. Mark Twain contributes a characteristic story of "Mrs. McWilliams and the Lightning." T. S. Perry writes instructively of Sir Walter Scott. Mrs Kate Gannett Wells discusses "Women in Organizations." Other stories, poems, essays, criticisms of new books, and a bright "Contributors' Club" complete a thoroughly enjoyable number of this magazine.

We have made arrangements with J. Fitzgerald & Co., of New York to furnish the *Humboldt Library* in connection with the Review, or to old subscribers of the Review, at a discount of 20 per cent. For particulars regarding the *Humboldt Library* see Book Notices on page 307 in this issue of the Review.

Harper's Magazine for September is a bright, strong number, rich in illustration, and piquant with several novel features. Especially novel in magazine literature is such an article as that by K. M. Rowland, on the Family of George III., illustrated with twenty-one portraits. A briefer article, entitled "The American Graces," is a biographical sketch, with beautiful portraits of the three Misses Caton, of Baltimore, who were respectively, Lady Stafford, Marchioness of Wellesley, and Duchess of Leeds. Mr. Conway contributes "The Seven Sleepers' Paradise beside the Loire." Mrs. Rebecca Harding Davis concludes her "By-paths in the Mountains" with a description of the North Carolina Mountains. Mr. Bishop also concludes his "Fish and Men in the Maine Islands," full of entertaining marine studies, effectively illustrated by Mr. Burn's sketches. Contrasting with all this beauty, but eminently picturesque in manner and illustration, is Mr. Rideing's article, "Squatter-life in New York." Miss Anna C. Brackett contributes a suggestive article, entitled "Indian and Negro," apropos of a recent visit to the Hampton school. In fiction the Number is very strong. The "Editor's Easy Chair" gossips in its best vein concerning old Newport, and the women of England and America, and gives some interesting reminiscences of the late George Ripley.

The September *Popular Science Monthly* well sustains its character as a magazine of valuable reading. It is the only periodical we have which reports progress in the higher and broader applications of science that concern everybody. Its contents for September are as follows: The Science of Comparative Jurisprudence, by William M. Ivins; State Educations: A Help or Hindrance? by the Hon. Auberon Herbert; How Animals Digest, by Herman L. Fairchild, (illustrated); The Solar System and its Neighbors, by C. B. Warring, Ph. D.; Legal Prosecutions of Animals, by William Jones, F. S. A.; Psychogenesis in the Human Infant, by Prof. W. Preyer; Climbing plants, by Francis Darwin, F. L. S., (illustrated); Æsthetic Feeling in Birds, by Prof. Grant Allen; Electricity and Agriculture, by Dr. Paget Higgs; Zoölogical Education, by Prof. W. S. Barnard; The English Precursors of Newton; Night-Schools in New York and Paris. by Alice H. Rhine; Sketch of Joseph Leidy, M. D., (with portrait); Correspondence; Editor's Table; Literary Notices; Popular Miscellany, and Notes.

We observe that Captain H. W. Howgate is very favorably spoken of as the successor of General Myer, late chief Signal Officer of the Army. His long experience (since 1863), and his devotion to meteorological studies render him peculiarly fitted for the place, but it is hardly to be hoped that the claims of other and ranking officers will be overlooked. Should the Signal Service proper and the Meteorological Service be dissociated, no one could fill the latter named place better.

L' Exploration. This valuable weekly continues to reach our sanctum regularly. Each number has inclosed a valuable map, which, in the copy before us, is a delineation of the new frontiers of Greece. The two former gave sections of Africa and are to be followed by additional sections, until a map of the whole of Africa, comprising the latest explorations, shall have been furnished. We translate the summary of contents as follows: The New Frontiers of Greece—Col. Prjévalski's Expedition to Thibet—Learned Societies—The Commercial Geographical Society of Bordeaux—The Normand Geographical Society—News from all Parts of the Globe—Europe—The Archæological Exploration in Ancient Lydia—Mourmain Exploration—Petroleum in Russia—Explorations in Siberia—Lake Onéga—The Caucasus—The Discovery of a Necropolis—Asia—The Kingdom of Israel—Fucus gummiflua—Explorations in Indo-China—Mineral Riches of Japan—Africa— Oriental Africa—New Belgian Expedition to Africa—The Eastern Cape—France and Western Africa—America Arctic Expeditions—Hudson River Tunnel—Niagara—Mouths of the Mississippi—Wild Lands of the United States—Oceanic—The Port-Breton Colony—Earthquake in the Phillipine Islands, et. J. F.

THE September Number of the *North American Review* contains the initial paper by M. D. Charnay on "The Ruins of Central America." This article is illustrated by photographs, which aid materially in the study of the text. An expedition under the auspices of the American and French governments, of which M. Charnay is in charge, is now operating in Central America, and the explorations are likely to create an interest more profound, and to be attended with more valuable archeological results, even than came from the researches of Champollion in Egypt. They promise a new chapter in American history that shall establish the origin of the remarkable race of which nothing but splendid ruins were left when Columbus discovered the new world. Following this article is one on "The Perpetuity of Chinese Institutions," from the pen of S. Wells Williams. Gen. John W. Clampitt, the surviving member of Mrs. Surratt's counsel, writes upon "The Trial of Mrs. Surratt." "The Personality of God" is discussed by W. T. Harris, LL. D R. B. Forbes gives some valuable suggestions in reference to "Steamboat Disasters." The Rev. Edward Everett Hale follows with a paper upon "Insincerity in the Pulpit." The number closes with a review of several recent works on the Brain and Nerves, by Dr. George M. Beard.

THE *American Naturalist* for September presents the following named original articles: The Syphonophores, by J. Walter Fewkes; Destruction of Obnoxious Insects by means of Fungoid Growths, by A. N. Prentiss; List of Birds of the Willamette Valley, Oregon, by O. B. Johnson, and Do Flying-Fish Fly? by C. O. Whitman. The Editor's Table is devoted to reasons why the Government should foster scientific research, and these reasons are set forth both forcibly and unanswerably. The General Notes, as usual, comprise a brief abstract of progress in Botany, Zoölogy, Anthropology, Geology, Paleontology, Geography and Microscopy. These abstracts are furnished by such scientists as Dr. Coues, Prof. O. T. Mason, Prof. Yarnall and Dr. R. H. Ward. The Book Reviews are written in a vigorous and comprehensive style, yet with fairness and liberality, and constitute a valuable feature of the magazine.

KANSAS CITY

Review of Science and Industry,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. OCTOBER, 1880. NO. 6.

PROCEEDINGS OF SOCIETIES.

THE AMERICAN SCIENCE ASSOCIATION.

The twenty-ninth meeting of the American Association for the Advancement of Science began in Boston, August 25. The meeting was called to order by the retiring President, Prof. George F. Barker, of Philadelphia, who immediately resigned the chair to the President-elect, the Hon. Lewis H. Morgan, of Rochester. President Rogers, of the Massachusetts Institute of Technology, delivered an introductory address, which was followed by addresses of welcome by Mayor Prince and Governor Long.

The secretary reported the deaths for the past year as follows: George W. Abbe, New York; E. B. Andrews, Lancaster, Ohio; Homer C. Blake, New York; Caleb Cooke, Salem, Mass.; Benjamin F. Mudge, Manhattan, Kansas; Thomas Nicholson, New Orleans; Louis Francis de Pourtelas, Cambridge, Mass.

A committee was appointed to draft resolutions on the death of Gen. Albert J. Myer, and another to send by cable the cordial greetings of the Association to the British Association at Swansea, on the occaaion of its fiftieth meeting.

The general session was then adjourned, and the various sections and sub-sections organized. In the afternoon, Section A was addressed by Prof. Asaph Hall, of Washington, who reviewed the recent advances in the science of astronomy, and the services rendered by men who, like Fraunhofer, have aided the work by optical and mechanical skill.

In the sub-section of chemistry, Prof. John M. Ordway reviewed the recent achievements of practical chemistry, and discussed its methods. The sub-section of anthropology was addressed by Major J. W. Powell, on the social organization and government of the Wyandotte Indians. In the evening, the retiring President, Prof. Barker, delivered the customary address, his subject being, "Some Modern Aspects of the Life Question." He took the ground that every action of the living body is, sooner or later, to be recognized as purely chemical or physical, the life that science has to deal with having no existence apart from matter.

The second day's meetings were held in Harvard College, Cambridge. The appointed eulogy on the late Prof. Henry was delivered by Prof. Alfred M. Thayer, who dwelt especially on Prof. Henry's work as a discoverer in science. The practical side of that work was touched in connection with the experiments which proved so beneficial to the light-house and fog-signal service. One discovery—that lard oil, when subjected to a heat of 280° Fahr., is superior to sperm oil in fluidity and illuminating power—saves the government $100,000 a year.

Prof. Alexander Agassiz, Vice-President of Section B., followed with an address on "Paleontological and Embryological Development," choosing his illustrations from a limited group of marine animals—*zaurchins*—having less than 300 living species, and more than 2,000 known fossil species.

The rest of the day was spent in the museums, laboratories, libraries, the observatory, and other buildings of Harvard College.

The reading of the 218 papers comprised in the programme was to begin on the third day, Friday, and continues until the final adjournment on Wednesday, September 1. Nearly 600 members were registered the first day, and fully 500 new members have been elected during the two days completed at this writing.—*Scientific American.*

THE BRITISH SCIENCE ASSOCIATION.

The fiftieth meeting of the British Assosiation, commenced on Wednesday at Swansea, and is likely to be a very successful gathering, the number of tickets issued up to that evening being 790, whilst the list of visitors is likely to be considerably increased. There was a large attendance in the Music Hall to hear the address of the President-elect, Professor Andrew Crombie Ramsay, Director-General of the Geological Survey of the United Kingdom. Upon the platform were professor Allman, the retiring President, Mr. Hussey Vivian, M. P., and many other well-known scientific gentlemen. The Mayor of Swansea having given the Association a hearty welcome to the greatest tin manufacturing county in the world, Prof. Allman resigned the chair, and introduced Prof. Ramsay as his successor.

Professor Ramsay having assumed the chair, proceeded to deliver his inaugural address. He said the chief object of this address was to attempt to show that whatever might have been the state of the world long before geological history began as now written in the rocks, all known formations were comparatively so recent in geological time that there was no reason to believe that they were produced under physical circumstances differing either in kind or degree from those with which we were now more or less familiar. All, or nearly all stratified formations had been in a sense metamorphosed, excepting certain limestone: the fact of loose, incoherent sediments having been by pressure and other agencies turned into solid rocks, constituted a kind of metamorphism. Common stratified rocks chiefly consist of marls, shales, slates, sandstones, conglomerates and limestones, generally distinct and definite; but not unfrequently a stratum or strata might partake of the characters in varied proportions of two or more of the above named species.

He would not discuss the theory of the causes which produced the metamorphism of stratified rocks; but he might say that under the influence of deep underground heat, aided by moisture, sandstones had been converted into quartzites, limestones had become crystalline, and in shaly, slaty and schistose rocks under like circumstances there was little or no development of new material, but rather in the main a rearrangement of constituencies according to their chemical affinities in rudely crystalline layers, which had been very often more or less developed in pre-existing planes of bedding. In Cornwall, Devonshire and Ireland it was now well known that metamorphic rocks were common, and the cases of metamorphism of Silurian rocks on the Continent could be easily multiplied. The same kind of phenomena were common in Canada, the United States and India. Turning to the Devonian and old red sandstone strata of England and Scotland, he found that metamorphic action had also been at work, but in a much smaller degree. These rocks were of the same geological age, though they were deposited under different conditions, the first being of marine and the latter of fresh-water origin. With regard to the carboniferous strata, he knew of no case where there had been a thorough metamorphism in Britain except that in South Wales, beds of coal in the west of Carmarthenshire and in South Pembrokeshire gradually passed from so-called bituminous coal into anthracite. He knew of no other strata that had suffered from metamorphic action, and he had never seen or heard of metamorphic rocks of later date than those that belonged to the Eocene series.

Enough, however had been said to prove that from the Laurentian epoch onward, the phenomenon of extreme metamorphism of strata had been of frequent recurrence, and extended partly to the Eocene series, equivalent to the soft, unaltered strata of the formations of the London and Paris basins, which, excepting for their fossil contents and sometimes highly inclined positions, looked as if they had only been recently deposited. Referring to the subject of volcanoes, the President said that the oldest volcanic products he knew of were of lower Silurian age, and they were to be found in Wales and other parts of England, but he knew of no true volcanic rock in the Upper Silurian series. In the Old Red Sandstone of Scotland lavas and volcanic ashes were of frequent occurrence, and they were also to be found throughout nearly the whole of the carboniferous sub-formations, as well as being associated with Permian strata in that country.

Volcanic rocks also existed in the Devonian strata of Devonshire, but he knew of none in America or on the Continent, and the only instance of a volcano of Eocene age known to him was that near Verona. There were, however, well preserved relics of Miocene volcanoes over many parts of Europe, and the evidence was clear that in nearly all geological ages they had played an important part, now in one region and now in another; and so far as his knowledge extended, at no period of geological history was there any sign of their having played a more important part than they did in the present epoch. The mountain chains of the world were of different geological ages, some of them being of great antiquity, and some of them comparatively modern. It was well known that in North America the Lower Silurian rocks lay unconformably upon the Lâurentian strata, and the disturbances which had taken place implied beyond a doubt that the Laurentian rocks formed a high mountain chain of pre-Silurian date, which had since constantly been worn away and degraded by sub-ærial denudation. It would not be difficult to add other cases of recurrences of the upheaval and origin of special mountain chains, some of which he could speak of from personal knowledge; but enough had been said to show the bearing of this question on the argument he had in view, namely, that of repetition of the same kind of events throughout all known geological time. The recurrence of rock and other salts strengthened his view. To give anything like a detailed account of all the fresh-water formations deposited in estuaries and lakes from the close of the Old Red Sandstone times down to late Tertiary epochs would be impossible in that address, but it might safely be inferred that something far more than the rudiments of our present continents existed long before Miocene times, and this accounted for the large areas of those continents, which were frequently occupied by Miocene fresh-water strata. With the main formations of Miocene age he was not now concerned, nor was it essential to his argument to deal with those later Tertiary phenomena, which in their upper stages so easily merged into the existing state of the world. The last special subject for discussion was the recurrence of glacial epochs, a subject still considered to be heretical by many, and which was generally looked upon as an absurd crotchet when in 1855 he first described to the Geological Society boulder beds containing ice-scratched stones and erratic blocks in the Permian strata of England. The same idea he afterward applied to some of the old red sandstone conglomerates, and of late years it had become so familiar, that the effect of glaciers had at length been noted by geologists from older paleozoic epochs down to the present day.

The conclusions he arrived at were these. In opening his address he began with the subject of the oldest metaphoric rocks that he had seen, the Laurentian strata, the deposition of which took place far from the beginning of recognized geological time, for there must have been older rocks by the degradation of which they were formed. Starting with the Laurentian rocks, he had shown that the phenomena of metamorphism of strata had been continued from that date all through the later formations or groups of formations down to and including part of the Eocene strata in some parts of the world. He had also shown that ordinary volcanic rocks had been ejected in Silurian, Devonian and other times, and from all that he had seen and read of these ancient volcanoes he had no reason to believe that volcanic forces played a more important part in any period of geological time than they did in this modern epoch. So also mountain chains existed before the deposition of the Silurian rocks, other of later date before the old red sandstone strata were formed, and the chain of the Ural before the deposition of the Permian beds. The deposition of salts from aqueous solutions in inland lakes and lagoons appeared to have taken place through all time and was still going on, and in like manner fresh water and estuarine conditions were found now in one region, now in another, throughout all the formations, or groups of formations, possibly from Silurian times onward, whilst what was termed the glacial epoch was now boldly declared to have occurred at intervals from almost the earliest Paleozoic times down to our last post-Pliocene "glacial epoch."

If the nebular hypothesis of astronomers be true—and he had no reason to doubt it—the earth was at one time in a purely gaseous state and afterward in a fluid condition, attended by intense heat. By and by consolidation, due to partial cooling, took place on the surface, and as radiation of heat went on the outer shell thickened. Radiation still going on, the interior fluid matter decreased in bulk, and by force of gravitation the outer shell, being drawn toward the interior, gave way, and in parts got crinkled up, and this, according to cosmogonists, was the origin of the earliest mountain-chains. This looked highly probable. But assuming that it was true, these hypothetical events took place so long before authentic geological history began, as written in the rocks, that the earliest of the physical events to which he had drawn their attention was to all human apprehension of time so enormously removed from these early assumed cosmical phenomena that they appeared to him to have been of comparatively quite modern occurence, and to indicate that from the Laurentian epoch down to the present day all the physical events in the history of the earth had varied neither in kind nor in intensity from those of which we now had experience. Perhaps many British geologists held similar opinions, but if that were so, it might not be altogether useless to consider the various subjects separately on which he depended to prove the point he had in view.—*Iron.*

ANTHROPOLOGY.

TERTIARY MAN.

TRANSLATED FROM THE FRENCH OF ZABOROWSKI, BY E. L. BERTHOUD, A. M.

(*Continued from June Number.*)

We do not believe it is possible to claim or admit that in this continued succession of changes, physical as well as organic, that man alone has remained unchanged, especially when we reflect that changes in living beings are more rapid in direct proportion to their more complicated organization.

Hence to suppose that the flint tools of Thénay may have been fashioned by a human being as far advanced, or rather we might better say, as highly developed as our present human races, is absolutely contrary to the fundamental laws of development, or the best recognized facts of palæontology.

In view of this consideration, and its incontestable force, the formation of these flint tools has first been by M. de Mortillet, attributed to a being whom he calls the "precursor of man," in its widest sense; that is to say, not only in the category of individual or species, but in that of a genus preceding man, from which could have sprung at least two types of human races.

M. Hovelacque has attempted an anatomical restoration of this presumed precursor to man after a comparison of anthropomorphous apes and the most ancient races of men, on the assumed explanation of their derivation from a common ancestor. We have no space now for a detailed account or analysis of this attempt; but suffice it to say it is well worthy of our attention, although hazardous from the present state of our knowledge on these points. But this comparison in itself is based on facts rigorously exact, and to-day admitted by Science.

When in 1874 we noticed and proclaimed this precursor of man as the author of the chipped flint tools of Thénay; we then admitted that our present knowledge of facts bearing on this question did not allow us to affirm that the human and simian branches were or were not separated in the Miocene epoch: and that with this being the true precursor of the human race, we indicated or mentioned the hypothesis of a varied *being*, a *species* not yet fully established, that we called then "Anthropiskes," (future men) among whom could have been operated a return to a type purely Simian.

Agreeing in this with Schleicher, who supposed that a certain number, or certain species of Anthropiskes had acquired under circumstances more or less favorable, the power of articulation, and had thus become men, while other branches of this genus less favored, had remained unchanged, had retrograded, even thus constituting in time the four present species of anthropomorphous apes.

We can also here remark that the flints of Thénay do not seem to have been fashioned for any special service or destination; they, perhaps, may have been split out by the action of fire, or accidentally, but thanks to this accidental formation, those who used them in their rough state were led little by little to fashion them into shape intentionally.

There are numerous instances that prove that monkeys nowadays know how to use pebbles and sticks. The most curious trait that we know, is related by Darwin of a monkey who used the same stone to break filberts constantly; and that he kept it hid in the straw.

After that we have not been at all surprised when we saw that M. Gaudry in a recent work declared that the most natural idea that presented itself to his mind was, that the flint tools of Thénay had been fashioned (taillés) or chipped, by the ancient Dryopithecus, this being exactly the big anthropomorphous ape discovered by Foutan, at St. Gaudens in France, and described by Mr. Ed. Lartet.

Unhappily we, as yet, possess only a lower jaw and a humerus. From an examination of these fragments, M. Gaudry concluded that he resembled man by several peculiarities. First by its size, which is very important, then by its incisors, and also by the rounded form of the rear molar protuberances, very similar to the molar teeth of Australians. But the size of the pre-molars and canines naturally produced extreme prognathism, or large advance of the face. This mark of inferiority, however, does not appear very striking, but we are much impressed with the general human aspect of the jaw, which M. Gaudry gives in a full sketch, which appearance is due not only to the broken canine, but to the contour of the chin, which, instead of giving a re-entering angle like apes, is almost straight, or like the human jaw from La Nanlette. M. Gaudry, however, does not notice this peculiarity.

We think it is sufficient at this time to pronounce it as certain that the human species, properly so called, did not exist in the Miocene epoch. Did it then exist in the Pliocene epoch? We can doubt this at least for the older Pliocene.

ANCIENT MAN IN MISSOURI.

The finding of numerous relics of a buried race, on an ancient horizon, from twenty to thirty feet below the present level of country in Missouri and Kansas, was noted in this paper a few months ago. The St. Louis *Republican* gives particulars of another find of an unmistakable character made last spring in Franklin county, Missouri, by Dr. R. W. Booth, who was engaged in iron mining about three miles from Dry Branch, a station on the St. Louis and Santa Fe railroad. At a depth of eighteen feet below the surface the miners uncovered a human skull, with portions of the ribs, vertebral column, and collar bone. With them were found two flint arrow heads of the most primitive type, imperfect in shape and barbed. A few pieces of charcoal were also found at the same time and place. Dr. Booth was fully aware of the importance of the discovery and tried to preserve everything found, but upon touching the skull it crumbled to dust, and some of the other bones broke into small pieces and partly crumbled away, but enough was preserved to fully establish the fact that they are human bones.

Some fifteen or twenty days subsequent to the first finding, at a depth of twenty-four feet below the surface, other bones were found—a thigh bone and a portion of the vertebra, and several pieces of charred wood, the bones apparently belonging to the first found skeelton. In both cases the bones rested upon a fibrous stratum, suspected at the time to be a fragment of coarse matting. This lay upon a floor of soft but solid iron ore, which retained the imprint of the fibers.

Overlying the last found bones was a stratum of what appeared to be loam or sod, from two and a half to three inches thick, below which was a deposit of soft red hematite iron ore, lying upon two large boulders of hard ore standing on edge, standing at an angle of about forty-five degrees, the upper ends leaning against each other, thus forming a considerable cavity which was filled with blue specular and hard red ore and clay, lying upon a floor of solid red hematite. It was in this cavity that the bones, matting and charred wood were found, intermixed with ore.

The indications are that the filled cavity had originally been a sort of cave, and that the supposed matting was more probably a layer of twigs, rushes, or weeds, which the inhabitants of the cave had used as a bed, as the fiber marks cross each other irregularly. The ore bed in which the remains were found, and part of which seems to have formed after the period of human occupation of the cave, lies in the second (or saccharoidal) sandstone of the Lower Silurian.—*Scientific American.*

THE SYNTHETIC PHILOSOPHY.

ITS ASPECTS AS A PHILOSOPHY.

W. H. MILLER, KANSAS CITY.

Nature, as man finds himself situated in it, presents the aspects of infinite extension, infinite multiplicity of forms, infinite activity and changeableness, infinite constancy of continuance and of laws of continual change. It enters into his conceptions as absolute in itself, or as containing a principle that is absolute from whence it proceeds and by which its activity is governed by infinite constant and immutable laws. Thus environed, man finds himself endowed with an insatiable longing to resolve the mystery of the environment, to know what it is, from whence it came, what its destiny, and what the purpose of its being.

The record man has preserved of himself in history recounts his efforts to resolve it and their results in mythology, theology and philosophy, each system of which has been partly accepted by one generation only to be rejected by another. Even anterior to the historic period, we find man had addressed himself to the same profound problem, for at the beginning of history he had his beliefs in gods to whose agency he attributed it. These beliefs stand for the net results of the efforts of pre-historic man; for mythology, as well as theology, are of the same nature as philosophy in so far as they attempt to account for the phenomena of things. Mythology and theology, however, in all the innumerable forms in which they have been presented, have been found inadequate to command universal acceptance, and to satisfy human longings. They begin by assuming gods, or a God, to whom the phenomena are due. This only transfers the mystery, for with such an explanation, which does not explain the phenomena of nature or of man, he becomes as eager to know of the gods, or God, as he was to know of nature. Yet to this conclusion, that there is a supreme being, infinite and absolute, whether we call it gods or God, the conditions of human intelligence force it by an irresistible necessity, while the emotional nature equally presses to the same end for something supreme and immutable as an object worthy of worship. To explain this supreme being is the function of philosophy and religion—the one revealing its aspects as related to nature, and the other as related to the moral aspects of man.

To consider the necessity man feels of an adequate explanation, the unceasing struggle he has made to find one, and his repeated failures, is to be filled with pity for his distressing situation and the misfortune that attends his struggles. As the *ignis fatuus* lures the lost traveler into impenetrable darkness and mire, nature leads man, bound by a spell he cannot break and lured by hopes it seems he cannot realize, into the depths of impenetrable mystery.

Mythology, having failed, has nearly vanished before the more definite forms and comprehensive scope and unity of theology. Theology, in offering no explanation of supreme being in itself and as related to nature, and only of its relations to the moral aspects of man, is not adequate; and the explanations it offers are distrusted by most, for how can relations be certainly explained and known until reality to which they relate is known? Philosophy, based upon the necessary conditions of things, has been found inadequate in its most elaborate and comprehensive forms, and does not satisfy. Hence the mystery remains.

In this situation man has taken to the study of nature itself, hoping that by sitting as a little child humbly at her feet, and patiently learning the lessons she teaches, to find the desired solution. In this much progress has been made; all departments of nature have been penetrated—astronomy, geology, chemistry, physics and naturalism in all their branches, and it is found that all teach the same lessons of infinite and immaculate laws, which reduce nature, with all its apparent heterogeneity to a consistent unity. These laws, founded as they are upon the accepted inductions of science, must be accepted as true. They too, like mythology, theology and the philosophy of the necessary, point to a supreme being that is infinite and absolute. Upon the inductions of science, serving as foundation for these laws, has been founded, also, the evolution hypothesis, which, during the past century has been so widely accepted by scientific men. To unify and explain nature by these laws, and in accord with the evolution hypothesis, is the purpose of the Synthetic Philosophy of Mr. Herbert Spencer, of which a republication in this country has been made during the current year. To examine this philosophy, as such, is the purpose of this paper.

It begins with an analysis of the teachings of science and religion, in which it is shown that the ultimate idea of both is that there is absolute and infinite being. It then explains that all knowledge of which man is capable is relative, and hence, as absolute and infinite being is not relative, knowledge of it transcends human power. Here the system might be charged with a grievous fault, for it is no explanation of a thing to say that it is unknowable. The conditions of philosophy are not complied with, and its function, which is to explain, is not discharged. Man's longing for knowledge is not satisfied, and if the conclusion be true, he is condemned to a most cruel fate in being compelled perpetually to seek to know that which is unknowable.

But to dismiss the subject here, as might justly be done, would not do justice to the merits and demerits of the system, both of which it possesses in large measure. It next explains that our idea of space is an abstract of our experiences of co-existent, resisting position. That is, that we continually meet with things in nature that occupy positions and resist our energies, and that by mentally abstracting these things from the positions occupied and leaving positions that do not resist, we attain the idea of space, or position that offers no resistance. Experience of force is, therefore, the foundation of our idea of space, whence it is concluded that force is the real being here met with. A similar analysis is made of our idea of time. Here the resisting positions, from experience with which the idea is derived, are successive instead of simultaneous. Hence here, also, our idea is an abstract of experience of force, and force is the being underlying it. Motion is shown to be only the sensible sign of something that moves, and as moving involves the exercise of force, force is here also the real being experienced. In regard to matter, it is shown that our knowledge of it arises from our experience of its resistance of our energy and its power to so affect us as to produce sensation. The ultimate reality in matter is, therefore, force. From these considerations it is concluded that the real being in nature, its ultimate, absolute principle, is force. That principle in man which is commonly known as the soul is manifest to us, it is claimed, as a force. It has activity, which implies force, and exhibits a form of motion which we know as intelligence. Therefore force is here the reality, and hence it is concluded that force is the ultimate principle of the universe, the real being that is infinite and absolute.

These inductions are presented as philosophy, not as science, and are not, therefore, to be classed with the accepted inductions of science which reveal the laws of phenomenal nature. They are super-scientific, and bring us up to the level of mythology and theology, which find in gods, or God, the ultimate, absolute and infinite principle of nature. It brings us also up to the level where philosophy finds its real problem—this ultimate, absolute, infinite first principle which it is its function to explain. But when we look to this evolution philosophy for such explanation we are disappointed. It tells us that force is inscrutable and thus, instead of satisfying the yearnings of humanity, it falls into absurdity by explaining all that is known into the unknown and unknowable, and thus makes the mystery it set itself to resolve, deeper and darker than it found it. Nor is this all; any system of philosophy must be consistent with itself. Here we are told on the one hand that force is wholly inscrutable, and on the other that it possesses activity, a number of most general laws of action, to explain which, as producing evolution, is the purpose of this philosophy. Now, if all knowledge is relative, it is necessary to think that being possessing these, or any other qualities, by which it may be known is not inscrutable. Either it is not unknowable, or it does not possess relations whereby it is known.

Here again it might be dismissed as philosophy were it not that it has not exhausted its material. There are inductions unmade that even an ordinary mind can supply, and perhaps many may supply to the detriment of truth. Let these be supplied and see if it will help it out of its absurdity.

Force being the ultimate principle in man and the ultimate, absolute and infinite principle in nature, both are the same, except that the one is special and the other general. Whatever qualities it exhibits in its special form, it must possess in its general form, for the general form being absolute and infinite must be the source of all qualities of the special form; there is no other source from which they could be derived, and to hold otherwise is absurd. Therefore when the special form exhibits a mode of motion that constitutes what we know as intelligence, will and emotion, that mode of motion must be exhibited also by the general form, and the conception at which we thus arrive is that of force as a personal deity infinite and absolute.

But if it be held that the mode of motion we know as intelligence in man is a modified form of motion resulting from the interaction of different forms of force, then there are deductions that apply. Let these be supplied and see if they will help this philosophy out of its absurdity. If force be the ultimate principle in nature, that of which all other things are composed, it seems necessary to conceive it as having existed in a pure state before things were evolved from it. In that case it seems equally necessary to conceive that force determined to organize things, and that it established laws that govern them. To have done this manifestly required the exercise of absolute will and infinite intelligence. And as will and intelligence cannot be conceived except as associated with conciousness, we find ourselves brought again to the conception of force as personal deity, infinite and absolute.

But as evolution denies creation, it may hold that there never was this semblance of it, but that force has existed from all eternity in an organized form, oscillating between a definite heterogeneity as we see it now, and an indefinite comparative homogeneity as in the nebulous state. This appears to be the doctrine really taught. Let this be granted and a different deduction applies. For in that case force exhibits an infinite variety of conditions, qualities and determinations. As infinite and absolute being it must be held to determine from time to time, and from form to form, the conditions, qualities and determinations to be assumed, which necessarily involve the constant exercise of absolute will and intelligence, hence consciousness, hence personality, and hence the conception of force as personal deity, infinite and absolute.

But it may be held that these conditions, qualities and determinations are not thus established, but are imposed upon force by the concrete and dependent forms it assumes, in which case we must conceive dependent being as having power to condition independent being, which is absurd. But if it were true, the conditions, qualities and determinations could be imposed only by consent of the independent being, and consent implies intelligence to consider and will to yield, hence consciousness, and hence a conception of force as personal deity infinite and absolute.

Or it may be held that the conditions, qualities and determinations are not the result either of self-establishment or of establishment by the dependent forms, but are the result of inter-action between the different forms. If this were true, it would yield us the conception of a world ruled by chance, which is manifestly not true, or force us to abandon all conceptions of force as the ultimate principle of nature.

But had this philosophy adopted any or all of these inductions and deductions, which are here shown to be possible to it, it would still be open to the fatal objection that force is known to be, not a thing in itself—a real entity—but only a quality of being. As motion is the sign of something that moves, so force is the quality that makes it move. Here the question arises, why is force of all the qualities of being, assumed as ultimate being itself? It is one of the best known of the qualities of being, as this philosophy shows in formulating its laws. It is also one of the most variable qualities, for some forms of being possess it in high degree, as dynamite, while others possess it in such low degree that to determine that they have more than mere gravitation, it is necessary to put them through a metamorphosis, whereby we cannot be certain if the force we develop resided primarily in the thing or was communicated to it by the metamorphosis. It is far less constant than the quality of existence, which belongs to all being equally, and it is less inscrutable, for existence can be defined only in terms of itself. To erect this quality into ultimate being would be as absurd as those primitive Grecian philosophies that thus erected fire, air, water and number into ultimate being, but not so absurd as thus to regard force because force is so much less constant.

Hence, the conclusion that evolution as a philosophy is a failure, not only in the form presented by Mr. Spencer, but in all forms in which it may be presented, so long as it presents force as the ultimate principle of nature, is irresistible. Yet it rests upon accepted induction of science, and upon laws that seem to explain and unify them. It is offered as a scientific doctrine, and as a reasonable and conceivable substitute for the creation hypothesis, which it holds to be of mythological origin and inexplicable and inconceivable in the light of modern science. To examine it in these aspects will be the purpose of another paper.

ENGINEERING.

SEWERAGE AND STREET PAVING IN KANSAS CITY.

BY ERMINE CASE, JR.

EDITOR REVIEW:—I see the questions of sewerage and of street paving are under serious discussion in Kansas City just now. The first should not be difficult. The general system of sewers should be built at once; be built in the best manner and the cost not counted, only so far as to get good work done at its real value. The district sewers should be ordered immediately thereafter, and every building required to make connections. There should be no hesitation or delay in this matter. Then only will the ponds, the noxious smells, malarial fevers and the cholera infantum disappear.

The determination of the paving question is more difficult, as there will be greater diversity of opinion, less information and a comparatively small number to pay the bills. Information and discrimination as well as economy and honesty should be brought to bear upon its solution. In view of the fact that the material constitutes by far the largest part of the expense of paving, it should be laid down as an axiom in the discussion of this matter, that a city should always use for paving purposes the material nearest at hand, if it be suitable. For this reason the attention of Kansas City is first directed to macadamizing with ordinary limestone. It should not be taken for granted that this is not the best paving for all our streets, business and residence alike. It is certainly far the cheapest, for the material is immediately at hand, and repairing can be cheaply done, so that its durability may be easily maintained. Our macadamizing has thus far been badly done and has never been kept clean. No other paving with the same treatment would be satisfactory. It can not be answered that this method has gone into disuse, for there many prominent streets in London, Paris, Berlin and smaller cities of Europe simply macadamized, although the granite block may be had in almost every hill on the continent.

However, I think there is a better material even than our hard limestone. The bed of the Osage river from the Trading Post to the Missouri, is full of a gravel that may be safely denominated perfect for the purposes of road-making. At every railroad crossing it may be had in unlimited quantities. It is not the dull, rotten stone-gravel of Ohio, but bright, hard flint, that rings like steel under a wheel, or the shoe of a horse. It does not require quarrying or even screening. There are several railroads crossing these beds, so that no one road can have a monopoly; the best place, however, will probably be Warsaw, less than thirty miles south of Sedalia, the haul being from that point less than one hundred and twenty-five miles. Let our streets be prepared with the usual bed of limestone, and then covered with this gravel, and we shall have a roadway practically indestructible. It can be put down and repaired without the use of machinery or skilled labor. It will produce as little dust and be as readily cleaned as any other pavement. I have no doubt of its being the best for our purposes.

Composition pavements, as used in the European cities, are made of Trinidad asphalt and crushed rock. They are delightful to ride over, and save the wear and tear of vehicle and animal to a very great extent. In icy weather this pavement is objectionably slippery. In Paris it is in use on many heavy business streets, while the Fleet and Cheapside, in London, on which are the heaviest traffic of any streets on earth, are laid with asphalt pavement. It can then be hardly called liable to the charge of want of durability. It would necessarily be more expensive than either of the pavements above mentioned, but the chief objection to it is that repairs are made with difficulty, a patch not being ordinarily successful.

The Granite pavement, or Belgian Block, I see is under consideration, but I do not understand how it can bear the test of comparison The granite must first be quarried, then cut into blocks of even size, and afterward transported twelve hundred miles, each operation being peculiarly expensive. Experts must lay it on an expensive bed, and heavy curbings on each side are required to keep it in place. Nor is that the end, for in New York and all other cities we see as many groups of men at work repairing it as on any other pavement. The wear and tear on horses and vehicles is terrific, ten times more than on any other road, which is no inconsiderable item, while the noise in streets of heavy traffic is a thing to make one shudder. It is true this pavement is more in use in European cities than any other, but that it is not universal, when it can be had, as I have said, in every hill, and labor so cheap, is one of the strongest arguments against its use. For Kansas City to send so far for a material which is liable to such an indictment would seem to be the height of unreason.

Wooden pavements have been discarded everywhere, and for many well known reasons are unworthy of discussion.

If Kansas City must send away from her bluffs for material to make streets, let her bring the gravel from the Osage. I am sure a drive down the Gravois over this bright ringing metal would settle the question for every one so doing. Whatever may be the pavement of the future in our city, even though it be of solid gold, it may as well be determined that cleaning is absolutely necessary to keep down mud in wet, and dust in windy weather.

INTERLAKEN, Switzerland,
Aug. 23d, 1880.

ENGINEERING PROGRESS IN THE UNITED STATES.

BY OCTAVE CHANUTE, V. P.

Annual Address Read at the Twelfth Annual Convention of the Society of American Civil Engineers, held at St. Louis, Mo., May 25th, 1880.

EXTRACTS.

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The first works in America for the supply of water to towns, were constructed by Hans Christopher Christiansen, and put in operation on June 20th, 1754, at the Moravian settlement of Bethlehem, in Pennsylvania.

The water from a spring, which is still used for the supply, was forced by a pump of lignum-vitæ of five inches bore, through hemlock logs into a wooden reservoir.

The same ingenious Dane, eight years later, replaced this rude pump by three iron pumps of four inches bore and eighteen inches stroke, which for many years were the only machinery for water supply on the Continent, and for seventy years furnished the water for Bethlehem.

Among the oldest, if not the very next in date to Bethlehem, is the Morristown, N. J., Water Company, which was incorporated in 1791, and has ever since furnished the town with water collected from the neighboring hills.

The first application of steam to pumping was in Philadelphia, in 1800, when the third steam engine of any considerable size in the United States was erected on the banks of the Schuylkill. It is believed that these works were the first constructed by a municipality. The first cast iron water pipes were laid in Philadelphia in 1804.

New York was first supplied by a company which erected a small pumping engine about 1800.

During the first thirty years of the century several small works were constructed, among others, at Cincinnati, in 1817; at Detroit, in 1827; at Lynchburgh, in 1828; Syracuse, in 1829; and Richmond, in 1830. Few of these works exhibited any great advance in engineering. The enlarged works for the supply of Philadelphia, by water power, constructed at Fairmount, in 1822, showed, however, a marked advance, and were for many years regarded as a model of efficient and economical works. The design and execution of the gravity supply works for New York and for Boston, between 1830 and 1840, were such as can not be greatly improved, even at the present day, except in minor details.

About 1850 the substitution of light wrought iron pipe, lined inside and out with hydraulic cement, for cast iron, at greatly reduced cost, was found to be practicable in many cases, and the formation of companies to manufacture and lay such pipes, introduced a commercial element into the matter of water supply and led to the construction of many works.

Improved forms of pumping machinery, which performed a fair duty at small expense for construction and maintenance, were designed and their manufacture became a special business.

The careful analysis and investigation employed in the construction of the works for the supply of Brooklyn, between 1850 and 1860, resulted in a more decided advance, in both theoretical and practical science, than had hitherto been made, the effects of which were seen during the succeeding decade in improvements in pipe manufacture, in engine building, in reservoir construction and in maintenance of works.

Between 1860 and 1870, a further impetus to water works construction, was given by the vigorous prosecution of an enterprise for building entire works for direct supply, by pumping into the mains without the intervention of a reservoir. The success attending this enterprise, owing to the small first cost of construction and to shrewd management, created competition, the result of which has been to force the adoption of scientific methods and the employment of skilled engineers, and as a consequence there has been great improvement in the types of machinery and in economical working.

The pumping machinery of large cities has also been greatly improved; the duty now required, and uniformly maintained, being at least fifty per cent. greater than it was thought possible to obtain twenty years ago, or than is now furnished by the less costly "commercial engines," of which two firms alone have built 242 for 168 towns, with an aggregate pumping capacity of 734 millions of gallons per day.

The construction by Mr. Chesbrough of a submarine tunnel for two miles under Lake Michigan, to furnish water for Chicago, was one of the boldest engineering feats of this country. Its successful completion was followed by the construction of several similar works.

On the Pacific coast, the use of unprotected wrought iron pipe for conveying great distances, and under great pressure, has proved very successful.

During the past ten years, the most important work executed, has been the enlargement of the gravity supply for Boston, by the construction of a conduit of masonry, in the designing and erection of which the latest and most perfect methods have been followed. The subjects to which particular attention has been paid by engineers during this period have been the efficiency of pumping machinery, the capacity of gathering grounds, the preservation of the purity of water, and the prevention of waste by consumers.

All American works are constructed for a constant supply, and most of those first built had a capacity far in excess of the then demand, which caused the formation of habits of wastefulness which it has been found difficult to check when the limit of the capacity was nearly reached.

The magnitude of the interests involved in this branch of engineering, may be judged from the fact that there are now in the United States and Canada 569 towns with a public water supply, having a population of about twelve millions, to whom there are daily distributed over six hundred millions of gallons of water, through thirteen thousand miles of pipes, of which about ten thousand miles are of cast iron.

About one-half of these towns are supplied by gravity, many of them however, having supplemental pumping power. The total capacity of the pumping engines now in use being about 1 900 millions of gallons per day.

Meanwhile improvements in plumbing and house distribution have greatly added to the convenience about our homes, and we now virtually have a spring of cold, and another of hot water, in almost every room of our city homes, to put on tap at will. * * * * * * *

RIVER IMPROVEMENTS.

We have as yet done little toward regulating and improving our rivers. Blessed with a magnificent system of internal navigation, which, as Mr. Fink and Mr. Blanchard have recently shown, virtually compete with and regulate freight upon almost all of our railroads, we have directed our attention rather to the craft that navigate them than to the streams themselves.

The further demand for cheaper transportation, however, as well as the higher spring floods and the lower summer waters, which come with the destruction of the forests, make it necessary that we should within a few years begin extensive river works. Colonel Mason, late member of this Society, showed us in building the St. Joseph Bridge that even the Missouri River was easily controlled, and made to flow wherever the engineer desired, by throwing out cheap and apparently frail brush dikes. A much greater and more original work has since been accomplished by the same simple means by our distinguished member, Captain James B. Eads, who, taking in hand the smallest and most unpromising pass of the Mississippi River, with seven feet of water over its bar, has in four years transformed it into the best access from the river to the sea, with thirty feet of water over the bar, at the cost to the nation of only $5.250,000, while the ship canal which had been proposed by other parties was estimated to cost $10,000,000.

The same far-seeing engineer is now engaged in studying the remainder of the course of the Mississippi River, and devising plans for its control and improvement. You have probably read the report to Congress of the board on which he has been acting, in which, differing widely from their predecessors, they propose to regulate the depth and flow of the river, by reducing its width at those points where it spreads into shallow sand bars.

The reasons by which these proposals are supported seem so sound, that it is to be hoped that our government will soon take steps to test the efficacy of the proposed methods upon an adequate scale.

The first of what is likely to prove a series of works to control the low water discharge of our rivers is being built upon the Ohio River at Davis' Island dam, five miles below Pittsburg. It seems a movable dam, of which you will find a brief description in *Scribner's Monthly Magazine* for this month (May, 1880).

The French have preceded us in works for regulating the flow of their navigable rivers, and have designed a number of types of movable dams (which they call "barrages"), which are well worthy of study and possibly of imitation. We shall doubtless make some changes, and perhaps improvements in them, to adapt them to our necessities and to our constructive methods; and this class of works should hereafter attract the study and attention of the members of profession more than has been the case hitherto.

The boldest and most interesting harbor work now being carried on by our government is probably the removal of the rocky obstructions in the East River of New York, at Hell Gate.

General Newton, as you know, sunk a shaft in the rock at Hallett's Point to a depth of some 50 feet below low water, honeycombed the rock with 7 426 lineal feet of galleries in various directions, and charging 4 427 drill holes in the remaining pillars and roof with 49 915 pounds of "rend rock," "vulcan powder," and "dynamite," blew up the whole Point, extending over three acres, and containing 63 135 cubic yards of rock, on the 24th of September, 1876. So accurately were the explosives located and proportioned, by the mathematical formulæ worked out for the occasion, that not the slightest damage was done to the surrounding houses and premises. The debris has since been removed with a grapple to a depth of 26 feet below low water.

General Newton is now engaged in undermining in a similar manner the rocky island of eight acres (mostly under water) known as "Flood Rock," in the same vicinity. He has sunk a shaft, and driven, to May 1, 1880, 5 273 lineal feet of galleries, from which he has removed 19 044 cubic yards of rock, leaving a roof varying from 8 to 19 feet in thickness between the top of the galleries and the water in the tide way, which is from 6 to 12 feet deep. The holes are all bored by machine drills driven by compressed air.

(*To be continued*).

SHIPS ON WHEELS.

CAPTAIN JAMES B. EADS.

A special meeting of the Chamber of Commerce was held at San Francisco recently, to allow Capt. James B. Eads, the famous engineer, to present his views on the subject of a ship railway, instead of a canal, across the Isthmus. After referring to the benefits accruing to the State from cheap transportation, Captain Eads said: The wheat surplus of last year, according to figures furnished me by Capt. Merry, was 600,000 tons, and it is estimated that this year the surplus will reach 800,000 tons. The average rate of freight around the Horn is $15 per ton, and after careful investigation it was found that such cargo could be transported by the Nicaraguan Canal at an aggregate cost of $10 per ton, thus saving upon the total annual shipment the large sum of nearly $4,000,000, or fifteen cents per bushel. I am told by some of your intelligent citizens, who have doubtless thought but little upon the subject, that they have grave doubts as to the value of a ship transit across the Isthmus, because it would probably lose to San Francisco the trade of the Orient. But must this trade, which no d ubt benefits this city to some extent, be enjoyed at the expense of the producers of the State? In the $4,000,000 of annual saving to the State to which I have alluded, reference is only made to your exports of wheat. If to this be added the increased value of that which is consumed in the State, and the saving on your other exports, the sum will be found great enough to pay for the cost of a ship railway in four years out of the benefits that will accrue to the people of this State alone. The railway which I propose will not cost more than one-half as much as the canal, and the fares being reduced, a further saving can be effected of $800,000 on wheat shipments alone. The canal would require eight years and the railway but four for construction, a saving in time whose money value to the State would be $20,000,000. The railway proposal may seem rather a wild dream to some, but I assure you it is perfectly practicable. It is not a novel one, having been employed for carrying canal-boats over the Alleghany mountains forty years ago. There is at present in operation within a few miles of Washington a railway upon which canal-boats, heavily laden with their cargoes, are daily transported up a steep grade from the Potomac river to the canal above. In Europe I know of at least two railways of a similar character now in operation. Surely if a railroad can be constructed of sufficient strength to carry a canal-boat, there is no reason why one could not be constructed strong enough to carry on ocean vessel. The work will necessarily be on a very large scale.

The road bed must be very solid, and to distribute the great weight I propose to use not less than twelve rails instead of two, with a multitude of wheels under each car One of the first objections presented to the mind by this plan, is the great weight to be borne by the road-bed. A cradle for a ship and cargo weighing 6,000 tons, would be about 350 feet long, and would rest on twelve rails spaced four feet apart; hence we would have a bearing forty-four feet wide by 350 long, which is 15,400 square feet. This is equal to 780 pounds only on each square foot of the road-bed. A brick wall eight feet high will give the same pressure. On each of the twelve rails, under a cradle 350 feet long, we would have 115 wheels. Each rail would then carry one-twelfth of the 6,000 tons, or 500 tons. This would be about four and one-third tons on each wheel. As the drivers of a large freight engine at rest give a pressure of over six tons each upon the rail, it will be seen that we really need no heavier rails and ties than are used on first-class railways. With the pressure of the ship thus distributed it is plain that she cannot bend, twist or strain in any way, unless the earth gives way under her, and this is not likely to occur if ordinary care be used in building and maintaining the road-bed. Any inequality in the level of the track can be compensated for by a strong spiral steel spring, allowing several inches of play. To avoid bending the ship in changing from one grade to another, the cradle would be run on to what may be called a tipping-table, placed in the line of the railway. This would rest on a fulcrum at the middle and on hydraulic rams at each end, so that the ends could be raised or lowered to conform to the different grades. To avoid curves in the railway, turn-tables long enough to receive the cradle would be placed at necessary points in the main track, and on these the cradle would be turned to the right or left to change the direction of the ship. The cradle will be nothing more than a moveable dry dock. This cradle or dock upon wheels will be backed down upon the railway, on a grade of about one foot in 100, until it reaches a sufficient depth of water to enable the vessel to be floated upon it. When the ship is in position she will be safely secured over the cradle, and then the car will be slowly drawn forward. As the water becomes more shallow, the vessel will naturally take her position upon the cradle; the supports will then be moved up against her hull, while still afloat, so that she can not move on the cradle, and she will be drawn up the incline until she reaches the level track above. Here two powerful engines will be attached, and the vessel will be at once started upon her journey across the Isthmus. At the end of her journey she will be put into the water in the same manner that she was taken out. The objection is urged with great pertinacity that it would be impossible to carry a vessel in this way without straining or injuring her, but the ablest engineers in the world, among them Hon. E. J. Reed, Chief Constructor of the British Navy, have declared that it can be done with perfect safety. The strain could not possibly be as severe as that experienced in rough weather at times at sea. If she bent at all in the direction in which she is most easily bent, longitudinally, she must bend the earth under her. A canal with locks would be a constant menace to your commerce, and an injury to one of the locks would suspend operations on the whole line.

Another strong objection is that a canal, once constructed, can not be enlarged to meet the wants of increasing commerce. No one knows, in view of the progress of ship-building, what the ships of the future will be, and a number of canals constructed years ago, of supposed ample size, are now useless, or nearly so. A tide-level canal, such as M. De Lesseps proposes, would cost from $300,000,000 to $400,000,000, and the cost of maintaining it would be beyond all reasonable estimate. In the report upon the Nicaraguan Canal, recently made to your Chamber of Commerce, it is estimated that 8 per cent per annum could be realized by the company, and the tolls not exceed $2 per ton. This estimate is based upon $100,000,000 as the aggregate cost of the work, which sum is less than one-third of that required to build the tide-level canal proposed by M. De Lesseps. The annual tonnage to be carried is placed at 1,000,000 tons below that estimated by De Lesseps—namely, at only 5,000,000 tons. Now, if the Nicaraguan Canal Company can pay an 8 per-cent dividend annually by the imposition of a toll of but $2 per ton, the same dividend can be declared by the ship railway upon the imposition of toll of but $1 per ton, for the reason that the cost of the ship railway will not exceed $50,000,000, or one-half the sum required for the construction of the canal; nor will its maintenance and operating expenses be in any greater proportion. I am convinced that the estimate of the cost of constructing the canal at Nicaragua is far below what it will actually cost, and that it can not possibly be built as proposed for less than $100,000,000. Should the proposed work be constructed, it will be found that the cost of improving the harbor at Greytown will far exceed any figure which the sanguine advocates of the scheme are now willing to place upon it. The cost of maintaining its harbors when improved, that of dredging the canal and keeping it and its locks in repair, and a hundred other minor expenses, demand the attention of those by whose products and labor the necessary interest on the capital invested must be paid.

Capt. Eads concludes as follows: "Standing in your presence to-day, and conscious of the full import of my words, I declare to you,

1. That a ship railway can be constructed at one-half the cost of a canal with locks, and in one-half the time.

2. That when completed, the railway can be maintained and operated at a cost not exceeding that of a canal.

3. That your largest vessels, with their cargoes, can be safely carried from ocean to ocean in one-half the time required for a passage through the canal. These considerations alone, it seems to me, should decide you at once in favor of the railway. But these are not the only ones. The railroad, when completed, can be enlarged from time to time, as the wants of commerce may demand. And should the commerce using the road demand a double instead of a single line of tracks, the work can be speedily done and at a reasonable expense, and without interfering with its traffic. Another matter which I desire to suggest is this: Wherever a canal is practicable, a railway is also practicable; and at some points a railway could be constructed where a canal would be out of the question. As you reduce the distance for the carrying of your freight you reduce the cost of transportation. There can be no doubt a ship railway could be constructed at Tehuantepec, and if this route were selected almost 700 miles of transportation could be saved over that necessary if the transit was by Nicaragua."—*San Francisco Chronicle.*

CULTIVATION AND PRESERVATION OF FORESTS.

Considering the great importance of the preservation of forests, and the lamentable want of foresight which permits their reckless destruction in nearly all parts of the world, but more particularly in our own continent, where forests will soon become scarcer and scarcer unless more practical measures are adopted for their preservation, it is satisfactory to be able to note that some Governments are recognizing the advisability of attempting the preservation of the forests they have under their charge. One of these, we are able to learn from a report published during the late Paris Exhibition, is the Government of France. The document in question, at the time it was issued, did not attract the attention it really deserves, and on that account we refer to it here somewhat fully.

We learn from the report that a large proportion of forest land does not necessarily exclude a numerous population. Compared with Germany, France has a third less of forest-covered soil, at the same time that she has a population less dense by one-eighth. Belgium, Holland, Denmark, and Great Britain, being either countries with a proportionally large sea coast or else islands, with an especially damp climate, may be left entirely out of the comparison, as they are able to exist without extensive forests. But there is no question that the retrograde process of Spain, her less dense population, is due in no small degree to the absence of forests, more especially as the uniformly mountainous nature of her soil requires, more than any other county, the prevalence of forests. Wherever this test is applied, it will be found (of course, speaking only of European countries) that fertility and density of population are closely connected with the presence of forests. It would form a generous undertaking for any Government to aim at an equalization in this direction. Whatever has been done in this respect in all countries has only been effected piecemeal; consequently it has been of but little influence on the whole. A common mode of procedure is what is wanted.

The experience gained by the French Office of Woods and Forests with regard to the acclimatization of foreign, especially trans-oceanic forest trees, is particularly valuable. The blue gum tree imported from Australia prospers in the South of France, and by its plantation at the mouth of the Var the marshes surrounding it have been drained, and the fevers formerly prevailing there banished. The trees prosper wonderfully in Algiers, as the section of a trunk not yet fifteen years old, of a diameter of one foot proves. But the wood is white, light, breaks easily, and cannot be compared with the durable, solid ship timber which the same tree produces in Australia. The same is the case with the American oak, which prospers in poor soil, grows quickly, and forms beautiful tops of foliage. But the wood is inferior, the bark contains less tannin than that of European oaks. Trees, consequently, can be planted in certain cases only as surrogates, principally to prepare the ground for better kinds. At present, experiments are also being made with the Californian theya tree, the wood of which is especially suitable for better classes of furniture; it is doubtful, however, whether its wood will not deteriorate by cultivation in Europe.

But the most important feature of the forest exhibition was the illustration of the planting of trees in places which require afforesting. This includes two very distinct categories, the afforesting of heights and the afforesting of dunes, as well as their turfing, for trees cannot prosper without the growth of grass. On the heights as well as on the sandy shores of the sea, the labors of the forest cultivator meet with unusual obstacles.

The bare lines of hills have, in winter, a superabundant of snow and water, while in summer they suffer from long-continued drought. By afforesting both evils are to be remedied, but the tree itself suffers most from them. The winds and storms to which the tops of mountains are exposed, and against which the trees are to protect them, as well as the slopes and the valleys which they form, are also a great drawback to the growth of trees. The forester must consequently apply especial means for attaining his object, the afforestation of lines of hills.

There are many depressions in mountains where the evils indicated are not so pronounced, and some protection against wind and too great drought is found. But the water, or rather the masses of water which are collecting in these depressions when the snow melts, have always sought an exit, and as they are acting with continuous and, on that account, resistless force, have found it. Each depression, each sinking of the soil in mountains, has been formed, long before the existence of man, into channels and gorges, whence in spring enormous bodies of water have precipitated themselves into the plains below, carrying with them masses of stone, earth, and roots. The first step, therefore, is to provide the gorge, which very often has been expanded into a valley, with obstacles against the precipitation of water. Weirs are consequently constructed at suitable distances across it. They either consist of a row of strong piles, the intervals between which are filled up by hurdle-work, or a strong, well-constructed dike is built of blocks of rock. The weirs must be made stronger and multiplied according to the length of the gorge and the quantity of water to be met. They retain the water for some time, which forms by its own action a broad smooth course, a small lake; all the small stones and dissolved particles of earth settle down, and soon form a broad, deep layer of fertile soil, on which grow first, grasses, then bushes, and finally trees. Humidity is here longer preserved by the water kept back, and the edges of the gorge afford some protection against winds and a too powerful sun.

As soon as bushes and trees have risen above the weirs, afforestation proceeds and extends rapidly. More fertile soil and humus accumulate, the gorge is gradually filled up, its slopes and edges become covered with grass, and upon grass follow regularly bush and tree. It becomes possible to lead the water from the weir by a horizontal channel over the edge upon the surface of the mountain, or rather the slope, where then the same series of growth is repeated. The verdure and trees already existing afford protection and supply moisture to the plantations growing on both sides of the filled-up gorge. The mountain thus becomes gradually covered with wood from the gorges. The further bush and tree are extending the longer snow and moisture are kept back, the waters rushing toward the gorge decrease, lose in violence, whereby the matter they carry with them is precipitated, and kept back more completely, and, in a corresponding degree, more nourishment conveyed to the plants. The impetuous mountain torrent, which during the short term of its yearly existence only causes mischief and devastation, is gradually tamed, but it flows during a longer period, for the snow retained by the trees no longer melts all at once. The further afforestation advances the further this development proceeds. Finally, the mountain is transformed into a quiet forest brook, which fertilizes the gorge by degrees almost entirely filled up, and never dries up. The mountain covered with forest makes the precipitation of moisture possible; springs break forth, whose waters seek the bed of the old tumbling and plunging torrent.

In the plain, also, this beneficial change makes itself felt. The never failing brook drives mill and machinery; it serves for the irrigation of meadows, fields, and gardens. On the lower slopes, since afforestation has been effected, vineyards, orchards, or fertile, if rugged, fields have sprung up. The afforested mountain protects from cold, excessive humidity, and exceeding aridity alike, but, especially, also from inundations. It tempers winter, cools summer, and prevents especially, many of the late night frosts which are so destructive to many of the most fertile plantations.

It is principally mountain chains of medium height where such works are possible as we have here pointed out. But lines of hills of small elevation, or swellings of the ground as we meet them in large plains, exert a similar influence on climate and weather if they are covered by forests. A great many will, at the present day, smile incredulously when they read how in the Middle Ages vineyards existed in all parts of Northern Germany, and a not inconsiderable trade was carried on with their products. And yet the explanation is as easy and as simple as it can possibly be. At that time nearly the whole country was still covered by large tracts of forest, the winters were consequently somewhat milder, frosts ceasing earlier in spring. As matter of fact, wherever the vine is cultivated in Germany at the present day, there we find the largest forests. Examples are not rare that as late as this century villages have suffered injury in the cultivation of the vine, or entirely lost it, because forests in the neighborhood have been destroyed. There is no protection in Germany against this wholesale destruction of forests. It is true there is a Ministry of Agriculture, and there are Boards of Health, but there is an absence of legislative enactments for the preservation of forests. It has been repeatedly suggested that existing German forests should be preserved, and, where practicable, schemes of afforestation carried out; at present, however, without any visible effect.

In France the state of the question is in a no more advanced condition. Afforestation proceeds but slowly, and yet France is acknowledged to possess the best law for afforesting mountains. From 1861-77 but 68,000 acres of mountain land were planted with trees, and further 3,700 acres turfed. The sum expended in those seventeen years was only £345,000, really an absurdly small amount for a country which has spent milliards on the improvement of Paris and other similar outlays, and which is on the point of expending other milliards on railways the utility of which is at least problematical. Need we wonder that inundations occur periodically, every time causing injury calculated by hundreds of millions?

The French law of afforestation already referred to, and passed in 1860, orders in its essential provisions that afforestation is to be promoted by public grants of seeds, young trees, money, and other means. Afforesting, if the state of the soil and other conditions make it appear necessary, may be made compulsory. If landed proprietors, communes, and others interested should decline to undertake themselves a regulated system of afforestation, this may be effected by the State, which may take possession for this purpose of the land in question. If persons interested wish, after completed afforestation, to enter again into possession of their soil, and consequently enter upon the enjoyment of the improvements effected by the State, they must repay to the latter the expenses incurred with interest, or cede instead half of the afforested soil.

The solidification of dunes by means of the growth of grass and the planting of trees offers difficulties of another kind. The question here is to "fix" the sand hills and sand heaps, shifted and driven about by the waves like balls. The work must be very gradual. A whole series of dunes is marked out, the line being drawn, as near as possible, over their crests. The parting off is effected by means of a strong fencing over the crest of the dunes, toward which smaller cross fences lean herring-bone fashion. The effect of this construction is the accumulation of ever increasing masses of sand in the places thus protected, which eventually form a bulwark for the space behind against the rush of the waves. The area thus inclosed is first planted with meadow grass, and next with coniferous trees, the latter being at first protected against sand drifts by means of brushwood. Sedges, broom, esparto grass also have been employed with advantage for first cultivation. The exhibition contained relief plans of the dune works and plantations of the dunes between the mouths of the Gironde and the Coubre. The soil reclaimed lies partly below the level of the sea, and amounts already to many thousand acres. Where, a hundred years ago, there was only a desolate and marshy expanse, there the eye now ranges over splendid forests, in which deciduous trees begin more and more to show themselves among firs and pines, while prosperous looking villages and large herds of cattle, gardens, and vineyards impart life to a landscape which was formerly a silent and dreary waste.—*The Builder.*

THE CANADIAN PACIFIC RAILWAY.

This work was commenced a year or two ago as a government enterprise, but the Ministry have apparently become somewhat frightened at the magnitude of the task or have become discouraged by the absence of aid from the Imperial Government which was expected at the inception of the undertaking. Be the cause what it may, it has been determined, if the proper parties come forward, to hand over the work to a public company; assistance and inducements being offered to promoters, as was done in the case of the transcontinental lines on the other side of the boundary. The total length of the projected system is 2,200 miles, of which it may be said 600 miles are either completed or under construction. The Government it is announced, are prepared to grant a subsidy of $20,000,000 in cash, payment to be spread over the period of ten years assumed to be necessary for the construction of the line, an amount equal to $10,000 per mile or about one-third of the estimated cost. A further grant will be made of 35,000,000 acres of land, to be located in alternate sections along the route, as was done in the case of the Union and Central Pacific companies. The 600 miles under construction will be handed over to the company without cost.

The history of the undertaking, so far under the direct control of the Canadian Government is as follows: The first expenditure on construction was toward the end of 1874. Contracts were then entered into for the telegraph from Lake Superior to British Columbia along the line of the railway, including the clearing of the forest land to a width of 132 feet. The line was divided into four sections, on three of which the work was prosecuted with vigor and the telegraph completed from Fort William to Edmonton, 1,200 miles, so that messages could be transmitted. The remaining section across the mountains to British Columbia remains incomplete. In the same year (1874) the grading of the Pembina branch for sixty-three miles north of the international boundary was commenced. In 1877 the grading was extended to Selkirk under the same contract, and in 1878 the track was laid on the whole length—eighty-five miles. In 1874 the extension of the Canada Central Railway to the eastern terminus, near Lake Nipissing, was subsidized. Early in 1875 the sections were placed under contract—the one from Fort William, thirty-three miles to Sunshine Creek, and the other east from Selkirk, seventy-six miles to Cross Lake, an extension east of Cross Lake, thirty-six miles to Keewatin, at the outlet of the Lake of the Woods, was placed under contract in January, 1877. In 1876 a contract was made for an extension from Sunshine Creek west to English River, eighty miles. In 1878 the Georgian Bay branch was undertaken; but this work was subsequently abandoned. For the spring of 1879 the line between English River and Keewatin, 185 miles was let in two contracts, and in the summer following a section of 100 miles west of Red River, including a branch from the main line to the city of Winnipeg, was placed under contract. At the British Columbia end of the line, ground was broken toward the close of last year, when the grading, bridging, track-laying and ballasting, from near Yale to Savona's Ferry, a distance of 127 miles was placed under contract.

The length now under construction is thus, as under:

	Miles.
Fort William to Selkirk (main line)	410
Selkirk to Emerson (Pembina branch)	85
West of Red River (main line and Winnipeg branch)	100
In British Columbia (main line)	127
Total under construction	722

A second 100 mile section west of the Red River has recently been let, making a total of 822 miles under construction, consisting of main line 720 miles and Pembina and Winnipeg branches 102 miles. In April last the rails were laid 136 miles west of Fort William and 90 miles east of Selkirk, and traffic trains are regularly run from Emerson to Cross Lake, 161 miles.

The cost of the route will, it is said, bear favorable comparison with that of the other completed and projected lines. The general summit is lower and the gradients more moderate. While the Central Pacific in climbing the Sierras, attains a height of over 7,000 feet, and the Union Pacific passes the Rocky Mountains at an elevation of over 8,000 feet, the Canadian Pacific has but one summit on its route, at Yellow Head Pass, where a level of 3,050 feet is reached. The cost of the 406 miles from Fort William to Selkirk, approaching completion, will be about $17,000,000, and for the Pembina branch the outlay has been $1,750,000. For the whole route from Lake Superior to the Pacific coast Mr. Sandford Fleming, the government engineer-in-chief, has made the following estimate, including a fair allowance for rolling stock and engineering during construction:

	Miles.	
Fort William to Selkirk	406	$17,000,000
Selkirk to Jaspar Valley	1,000	13,000,000
Jaspar to Lake Kamloops	335	15,500,000
Lake Kamloops to Yale	125	10,000,000
Yale to Fort Moody	90	3,500,000
Add say	—	1,000,000
Totals	1,956	$60,000,000

The above does not include cost of exploration and preliminary surveys over a wide extent of country between latitude 49° and 56°, along the route, amounting to over $3,000,000, nor the cost of the Pembina branch, $1,750,000 nor other amounts with which the Pacific Railway account of the Government is already charged. In the course of the surveys three alternative routes through the mountains into British Columbia have been laid down in addition to the line as finally fixed to Burrard Inlet. All of these are further to the north than the selected line, and average about 200 miles greater length. They follow respectively the Peace River Pass and the Pine River Pass, and it is recommended that one or the other be constructed when practicable on account of the value of the territory thus to be opened.

The last report of Mr. Fleming also covers urgent recommendations as to the establishment of a Pacific submarine cable in connection with the Canadian Pacific Telegraph system. The cable, it is suggested, may start from one of the deep water inlets at the north end of Vancouver's Island, and be sunk in a direct course to Japan, or it may touch about midway, Ambia, one of the Aleutian Islands. At Yeddo, in Japan, the connection would be made with the Asiatic telegraphs. As an alternative route the submarine may land on one of the Kurile Islands north of Japan, and thence extend direct to Hong Kong. Either course would complete the connection with the whole Eastern telegraph system and effect important results. Such a line would connect all the great business centers of America with China and the principal ports of Asia much more directly than by the present lines of telegraph by way of Europe. The new line would be employed for the most part by the English speaking people of both hemispheres, and the frequent mistakes of polyglot telegraph operators in Europe be avoided. The further inducement is held out that it would bring Great Britain, Canada, India, Australia, New Zealand, South Africa, and all the outer provinces and colonial possessions of Great Britain into unbroken telegraphic communication with each other in entire independence of the lines which pass through other European countries.—*N. Y. Herald.*

ASTRONOMY.

PLANETARY PHENOMENA FOR OCTOBER, 1880.

BY W. W. ALEXANDER, KANSAS CITY.

Mercury sets on the 1st at 6 h. 03 m. p. m., and on the 31st, 5 h. 53 m. p. m. It is unfavorably situated for observation during this month, owing to its being so far south in declination.

Venus sets on the 1st at 6 h. 34 m. p. m., and on the 31st at 6 h. 24 m. p. m., and like Mercury, is too far south of the sun to show to advantage.

Mars is in conjunction with the sun and can not be seen.

Jupiter is in the best position possible for observation, being on the 7th in opposition or 180 degrees from the sun. It rises as follows: On the 1st at 6 h. 00 m. p. m., and on the 31st at 3 h. 52 m. p. m.

The following is a brief summary of the phenomena presented by its four Moons, Io, Europa, Ganymede and Callisto, the time used being Kansas City mean solar time.

On the 1st at 9 h. 30 m. p. m., Io reappears after occultation.

On the 5th at 11 h. 12 m. p. m., a small round black spot will appear on the eastern edge of the planet's disk, it being the shadow of Ganymede, which satellite will follow in 18 minutes, and both will make a transit of the planet's disk.

On the 7th, at 11 h. 50 m. p. m., Io and its shadow will enter on the planet's disk at the same time and pass across in transit.

On the 8th at 11 h. 15 m. 27 s., Io will suddenly reappear, coming out of Jupiter's shadow, and will be very close to the eastern edge of the planet.

On the 9th at 7 h. 06 m. 22 s. p. m., Europa reappears after being eclipsed.

On the same day at 8 h. 28 m. p. m., Io will pass off the western edge of the planets disk, followed in 5 minutes by its shadow.

On the 14th at 11 h. 57 m. p. m., Europa will enter on the planet in transit, followed by its shadow in 23 minutes.

On the 15th at 10 h. 45 m. p. m., Io will disappear behind the planet's disk.

On the 16th at 7 h. 32 m. 07 s. p. m., Ganymede will suddenly reappear at some distance to the east of the planet.

On the 17th at 7 h. 39 m. 26 s. p. m., Io reappears to the east of the planet.

On the 23d at 7 h. 26 m. p. m., Ganymede will disappear behind the western edge of the planet, and at 8 h. 45 m. p. m., Europa will likewise disappear and at 11 h. 33 m. 53 s p. m., Ganymede will suddenly reappear at some distance from the planet on the east side. Europa will likewise reappear at 11 m. 50 s. past midnight.

On the 24th at 9 h. 34 m. 50 s. p. m, Io will reappear after being eclipsed.

On the 25th in the early evening two small round black spots may be seen near the western edge of Jupiter's disk, and at 6 h. 51 m p. m., the one nearest to the edge will pass off followed by the other in 7 minutes. They are the shadows of Io and Europa.

On the morning of the 31st at 1 h. 10 m., Ganymede will reappear, coming from behind the planet and at 1 h. 16 m. 35 s., will plunge into Jupiter's shadow and disappear, being visible a little more than 6 minutes.

On the 31st at 8 h. 50 m. p. m., Io will disappear by being occulted, and reappears from being eclipsed at 11 h. 30 m. 20 s. p. m.

Saturn rises as follows: On the 1st at 6 h. 32 m. p m. On the 31st at 4 h. 28 m p. m., and for observation is favorably situated, being in opposition to the sun on the 18th at 6 h. a. m.

This is one of the most remarkable planets in this solar system, being encircled with a system of thin rings extending out in the plane of the planet's equator to a distance of more than 83,000 miles from the planet's center. On the 7th we are 14° 30′ above the plane of the southern surface of the rings, which elevation is slowly decreasing during the next two months, owing to the motion of the earth in its orbit.

Uranus rises on the 1st at 3 h. 43 m. a. m. On the 31st, at 1 h. 44 m. a. m. It can only be seen by morning observers.

Neptune rises on the 1st at 7 h. 15 m. p. m. On the 31st, at 5 h. 14 m. p. m.

Our moon begins its monthly course by passing the sun on the 4th, and Mercury and Venus on the 5th. On the evening of the 7th it will pass 2° north of Antares, the brightest star in Scorpio. On the 17th, at 5 h. a. m., it will pass north of Jupiter 7° 1′ of arc, and on the 18th, at 4 h. a.m., it will pass north of Saturn 7° 44′ of arc. During the month it occultates 13 stars of the 3d to 6th magnitudes.

AN ASTRONOMICAL DISCOVERY.

Professor E. C. Pickering, director of the Harvard Observatory, lately made a discovery which is regarded as one of the most important of the century in stellar physics. In the ordinary telescope a star appears as a point of light, brighter, but not larger than when looked at with the naked eye. Prof. Pickering finds that, on placing a prism between the object glass and the eyepiece of his telescope, the light of a star is drawn out into a continuous band. When, however, the telescope with the prism is directed to a planetary nebula, the light is collected into a star-like point without any band, enabling the astronomer to distinguish instantly between a star and a planetary nebula. This principle has already enabled Prof. Pickering to discover several planetary nebulæ. On Thursday evening, August 26th, an object was observed which presented the appearance of two star-like points within the band in the modified telescope. It is different from anything heretofore observed in the telescope, and is regarded as an important object for investigation.

THE LIGHT OF JUPITER.

There has been for some years a discussion as to whether the planet Jupiter shines to any perceptible extent by his own intrinsic light, or whether the illumination is altogether derived from the sun. Some facts ascertained from spectroscopic observati n by Prof. Henry Draper, and communicated by him to the current number of the *American Journal of Science and Arts*, seem to point to the conclusion that it is not improbable that Jupiter is still hot enough to give out light, though perhaps only in a periodic or eruptive manner. Most of the photographs hitherto made of the spectrum of Jupiter by Prof. Draper, bear so close a resemblance to those of the sun as to indicate that under the ordinary circumstances of observation, almost all the light coming to the earth from Jupiter must be merely reflected light originating in the sun. But on one occasion—Sept. 27, 1879—a spectrum of Jupiter with a comparison spectrum of the moon was obtained by him which showed a different state of things. The photograph which was taken of this shows, not a change in the number or arrangement of the Fraunhofer lines, but a variation in the strength of the background. These modifications in the intensity of the background seem to Prof. Draper to point out two things that are occurring: (1.) An absorption of solar light in the equatorial regions of the planet. (2.) A production of intrinsic light at the same place. These two apparently opposing statements can be reconciled on the hypothesis that the temperature of the incandescent substances producing light at the equatorial regions of Jupiter did not suffice for the emission of the more refrangible rays, and that there were present materials which absorbed those rays from the sunlight falling on the planet. The strengthening of the spectrum in the portions answering to the vicinity of the equatorial regions of Jupiter, says Prof. Draper, bears so directly on the problem of the physical condition of the planet as to incandescence that its importance cannot be overrated.—*Scientific American.*

BIOGRAPHY.

NORDENSKJÖLD'S LABORS.

BY JOHN RAE, M.D., LL.D., F.R.S., LONDON, ENGLAND.

Before entering upon the Arctic career—which has recently culminated in so grand a success—of the subject of this paper, it may not be out of place to give a very brief notice of his previous by no means uneventful life, for all, or nearly all, of which I am indebted to "The Arctic Voyages of Adolf Erick Nordenskjöld, 1858—1879," published by Macmillan & Co., 1879.

Nordenskjöld is a native of Finland, and was born at Helsingfors, in November, 1832, of a race known for many generations to possess great qualities. Whilst yet a boy, he was an industrious collector of minerals and insects, and accompanied his father, a well-known naturalist, on many of his excursions, thus preparing himself, without being aware of it, for his future great work. At first he was extremely idle when at school, his free spirit refusing to be under due discipline; but when this discipline was relaxed, he became very industrious and attentive, and was soon among those who obtained the best reports.

At this school—the Gymnasium at Borgo—a revolution took place, in 1848, among the pupils, in consequence of two of them being subjected to corporal punishment, and nearly half the young men had to leave the institution—among them Nordenskjöld.

His chief studies in the University of Helsingfors—which he entered in 1849—were Chemistry, Natural History, Mathematics, Physics, and, above all, Mineralogy and Geology. He had already acquired much skill in recognizing and collecting minerals during his father's tours, so that he was at an early age found capable of taking charge of the fine mineral collection at Frugord. "By these experiences he acquired a keen and certain eye for recognizing minerals." After passing his examination, in 1853, he accompanied his father on a mineralogical excursion to Ural, and paid much attention to the iron and copper mines. On his return, he continued his favorite studies, and about the year 1855–56, wrote papers on the "Crystalline Forms of Graphite and Chondrodite," "A Description of the Minerals found in Finland," various articles on Mineralogy and Molecular Chemistry, etc.; and also, in conjunction with another gentleman, "The Mollusca of Finland." He was during this time appointed Curator of the Mathematico-Physical faculty, and Mining Engineer Extraordinary, to each of which a small salary was attached.

He did not, however, long enjoy these his first paid appointments, having been removed before his second quarter's salary was paid, because of some political speeches made in "heedless fun and frolic" at a convivial dinner, where one of those present parodied, in a very effective manner, a famous speech of Palmerston's about the taking of the Baltic fortresses. This difficulty ended in Nordenskjöld having to leave his native land and take up his quarters for a time at Berlin, where he continued his pet studies, and made the acquaintance of some distinguished men, to whom his father's well-known name was a most favorable introduction.

He returned to Finland, was offered positions of honor and emolument, but in consequence of an imprudent speech, had again to leave that country for a time; the Governor General, Von Berg, being evidently inimical to him. During this period of exile he made his first Arctic voyage with Torell to Spitzbergen, in 1858, in the autumn of which he again visited Finland, and was offered a situation of trust, but difficulties were raised by Von Berg, to whom he would not express regret for what he had done, and "who told him he must bid good-bye to Finland." He got his passport, and in fourteen days crossed the frontier into Sweden, of which country he became a naturalized citizen. Subsequent to 1862, when Von Berg—who had cruelly denied Nordenskjöld the privilege of visiting his dying mother—had ceased to be Governor General, he was permitted to visit Finland whenever he pleased.

In the season of 1858–9, he was appointed to take charge of the Mineralogical Department of Riks Museum at Stockholm, vacant by the death of the former able Curator, Mosander. His whole history at this time is a continuous record of constant and useful scientific work, showing great capacity and energy, both mental and physical.

In 1864 he went on his first Arctic expedition under his own command, with very limited means, and in a small sailing vessel. The results were much less than were looked for (although during this summer the sea was very free from ice), in consequence of his meeting, when sailing northward, seven boats laden with walrus hunters, from vessels that had been wrecked, with whom he was compelled to return immediately to Norway. The sales of animals, etc., killed during this expedition paid part of the expenses.

A strenuous effort was made by Nordenskjöld, during the summer of 1868, to reach a high northern latitude in the iron steamer "Sofia,"* far too weak, both in build and steam power, to contend successfully with the ice-pack usually found north of Spitzbergen; nevertheless, he reached the very high latitude of 81° 42′ N., on the 18th of September, this being the highest well authenticated latitude reached by any vessel (Parry's boats in 1827 excepted) at this date. Later on in the season, the vessel leaked so badly, from a blow against an ice floe, that she was with difficulty brought back to her old anchorage in one of the Spitzbergen harbors, where she was beached and the damage patched up.

On his return from this expedition, Nordenskjöld was awarded the Founders' gold medal by the Royal Geographical Society of London.

I am happy to find that this experienced, truthful, and distinguished explorer is of opinion that, "in a not *too unfavorable* year, it would certainly be possible to reach, from the northwestern extremity of Spitzbergen, a far higher latitude than Sir George Nares' vessel attained during the last English Polar Expedition." †

In 1872, that admirably generous and public spirited gentleman, Mr. Oscar Dickson, again nobly volunteered the funds requisite for another Polar expedition, with the same object as the last, but on this occasion sledging over the ice was to be attempted.

Nordenskjöld closely discussed the question as to whether reindeer or dogs were best as draught animals, and to settle this question satisfactorily he paid Greenland a visit in 1870. So as to utilize this Greenland tour to the utmost, he made an excursion over the inland ice of this ill-named country, which is certainly the reverse of "green." He was accompanied on the ice by the botanist, Berggren, and on this of all places the most unlikely for a botanist to find anything worthy of notice in his own special science, the remarkable discovery was made that this ice was everywhere covered with a scanty vegetation of microscopic algæ. Their progress was interrupted by many crevasses, so that they reached only about thirty miles inland.

Nordenskjöld determined on taking with him reindeer instead of dogs, because they would serve as food, each deer being counted upon as yielding upward of 100 lbs. venison; but the deer required so large a supply of mosses and lichens for food, that an extra vessel had to be hired for their transport.

This year (1872) the state of the ice on the northern shores of Spitzbergen was found unusually rough and unfavorable, and, to make matters worse, the reindeer all escaped very soon after they were put on shore. The auxiliary vessel already mentioned and another which had been required, were to have returned to Sweden immediately after discharging their cargoes, but were unfor-

* An iron steamer is not so good for Arctic service as one built of wood. The cold makes the iron brittle. —J. R.

† This line of route I have consistently advocated for more than a quarter of a century, chiefly on account of Parry's experience of 1827, and because there is, as far as yet known, a channel 300 miles wide for the ice to move freely in, instead of narrow straits leading northward, which, according to my own experience, and that of others, are impenetrably blocked up with ice, either at one end or the other.—J. R.

tunately shut up by the ice in Mussel Bay—an unusual thing—and, not having provisions enough for wintering, the supply of food taken for the crew of one vessel was too small to feed so many mouths; the difficulties were further increased by their being obliged to receive and give rations to a number of shipwrecked walrus hunters, who otherwise would have starved.

The expedition, useful in other respects, was a perfect failure in its main object, that of getting far to north.

As these two last expeditions were wholly with the object of making a great progress Poleward, I shall offer a few remarks on the various routes to the Pole, either already attempted or in prospect, before describing Nordenskjöld's most recent and grandly successful Arctic voyage to the northeast; thinking it may be of interest to those who have not made Arctic voyages especially their study, to point out the various routes to the North Pole that have been attempted, and to mention the difficulties that have been encountered, and their causes, in the efforts to make the northwest passage, which has been discovered, but has never been made in the true sense of the word, that is, by a vessel passing from the Atlantic to the Pacific ocean, or *vice versa*, northward of the American Continent.

Contrary to the theories of many presumably good Arctic authorites, who advocate narrow channels of the sea for Arctic navigation, such channels have, in practice, been found the worst possible for this purpose, especially when their direction lay in anything approaching to a north and south course, as they have always been blocked with impenetrable ice in one part or other. As examples of this, I may mention Smith Sound, which was found completely sealed up by the ice-pack at its northern outlet in 1875. In the narrow Fury and Hecla Strait, Parry's advance westward was stopped by close packed ice at its western opening in 1823.

Franklin's northward progress through Wellington Channel must have been stopped in a similar manner in 1845, for he turned back the same year. In 1846, '47, '48, the ships of the same good and noble but unfortunate navigator were shut up *by* and abandoned *in* the ice, near the south entrance of the somewhat narrow channel, named by me Victoria Strait in 1851; the pressure of the ice-pack coming down from the northwest through McClintock Channel, and checked in its progress by King William's Land, must, from my experience of it, have been immense. Franklin's officers did not at that time know—a fact ascertained by me in 1854—that King William's Land was an island, and that, by passing eastward of it, the ice pressure might in a great measure have been avoided.

Bellot Strait, which bounds the extreme north point of America in latitude 71° 57′ N., was found impracticable by the Fox, in 1858-9, in consequence of the ice-pack at its western end.

Prince of Wales's Strait—another narrow channel—separating Banks Land from Wollaston Land, was of easy access from the south, both by McClure in

1850, and by Collinson in 1851, but its northern entrance was completely sealed up by the ice floes.

Finally, Banks Strait was a fatal obstruction—fatal I mean as regards the making of the northwest passage—to Parry sailing westward in 1819, and equally so to McClure in 1851, '52, and '53, going eastward from Behring Strait, when he had to abandon his ship in Mercy Bay, and with his crew take refuge on board Kellett's vessels, which were also abandoned. They then took passage in an auxiliary steamer to England *via.* Lancaster Sound and Davis Straits, thus making or finding a northwest passage by walking one or two hundred miles over the ice-covered sea.

Sea channels having an east and west direction, when of considerable length, are usually pretty free from obstruction, as the land to the north in a great measure prevents ice pressure from that direction.

An idea has recently been started, and papers have been read on the subject, advocating an advance Pole-ward between the meridians of 50° and 60° east longitude to Franz Joseph Land, which is acknowledged to be *possible* of approach about once in every five or six years. If this assumption is correct, as I presume it may be, because mentioned by the advocates of this route, it must be most dangerous, for, supposing a ship to reach the south portion of Franz Joseph Land in *the* favorable year, she would in all probability be shut up and prevented from getting back for five or six years—a much longer detention than is either safe or desirable.

I have already quoted Nordenskjöld's favorable opinion of the northward route *via* the west shore of Spitzbergen, where we know there is a wide channel of sea as far as 83° north latitude, seen by Parry in 1827. That greatest of Arctic navigators, when in latitude 82° 45′ N., could not find an ice-floe sufficiently large and strong to haul his boats upon, so as to protect them from being nipped, and remarks in his journal, "such was the state of the ice at this my extreme north point"—the fact being that, the farther north he went the smaller and weaker the floes became. This Spitzbergen route has never been attempted by large, well equipped, and powerful screw steamers such as those of Nares in 1875, or like the fine ships now almost universally used by the seal hunters from Dundee and Peterhead.

Previous to his great undertaking which ended so gloriously, Nordenskjöld undertook two preliminary shorter voyages, as it were to feel the way. For this purpose he made a voyage eastward in 1875, with a small sailing sloop of 70 tons burden, crossed the Kara Sea, and reached the Yeniessei River without difficulty, the vessel returning the same season by the same route. Almost everything intended by this expedition was effected—something unusual in Arctic discovery. It being supposed that the cause of success in 1875 was an unusually favorable state of the ice, Nordenskjöld went the following year by nearly the same course in a steamer of 400 tons, and made the voyage with equal success—thus proving, as far as possible where such an uncertain element of obstruction as ice movement is concerned, the practicability of navigating these seas.

The earliest recorded attempt to find a northeast passage—that is, to take a vessel from the Atlantic to the Pacific ocean, north of Europe and Asia, *via* Behring Strait—was that of Sir Hugh Willoughby, more than three hundred years ago. He and his whole crew were found frozen to death (probably starved), where they had been wintering on the shores of Russian Lapland. This expedition, consisting of three small vessels, sailed in 1553.

A number of other expeditions were sent out in the 16th and 17th centuries with the same object, under commanders whose names appear prominently in our more recent Arctic maps (see Stanford's Circumpolar Maps), the most conspicuous being those of Barentz (a Dutchman) and Hudson. Later on, the Russians undertook the exploration of these seas, and sent out no fewer than eighteen expeditions, all of which failed in their main object. The last of these returned in 1837, on which Von Baer, the Academician, asserted *it was an ice cellar.*

For Nordenskjöld's great voyage, the patriotic and generous Mr. Oscar Dickson, already so frequently mentioned, contributed £12,000, including the purchase of the "Vega," a steam whaler of 500 tons and 60 horse-power, this being a much finer vessel in every respect—apart from the great advantage of steam-power—than was ever previously employed for the contemplated work. By a grant from the king of Sweden of £2,200, and an equal amount from a Russian gentleman, Mr. Alexr. Sibiriakoff, with other subscriptions, the sum of £20,000 was obtained.

The minor objects of this expedition were too numerous to mention in a notice so brief as this; it is sufficient to say that with so experienced and scientific a leader and an admirable staff of able men to support him, no single pursuit that could tend either to the advancement of science or of industrial development was neglected. The expedition was extremely fortunate in having as captain of the "Vega," Lieut. Palander, who, although still young, had already had much experience of ice navigation. The crew of the "Vega" consisted of thirty persons in all, of whom nine were officers and scientists, three Norwegian walrus hunters, and the remaining eighteen picked from about 200 volunteer seamen of the Swedish navy. They were fully provisioned for two years.

The "Vega" sailed from Gottenborg on the 4th of July, 1878, and from Tromsoe on the 21st, accompanied from the latter place by the small steamer "Lena," bound for the river of that name.

On the 30th of the same month, the "Vega" reached the shores of the Kara Sea, and anchored at Chabarova, a Samoyede village, near which the two vessels Fraser and Express had been at anchor since the 20th, and had seen no ice all these ten days. The Lena arrived on the 31st, and both she and the "Vega" took on board coals from the Express, and then sailed on the 1st of August. The whole of the Kara Sea was traversed without seeing ice, except one "drift" of floes too rotten or broken up to impede navigation. On the 6th of August they came near to anchor in Dickson's Harbor, in lat. 73° 25′ N., long. 82° E. (?), having advanced more than 500 miles in six days.

After spending a day in surveying the harbor, the vessels continued their eastward voyage.

On the 19th of August the first object of the expedition was accomplished, by its arrival at the extreme north point of the Old World, named variously Cape Chelyuskin, Cape Severo, or Northeast Cape, its latitude being 77° 41′ N., longitude 104° 1′ E. On this part of the voyage a good deal of detention had been caused by fogs, but the little ice met with had been either too much decayed or the floes too open to prevent the easy and safe passage of the steamers, being rather an advantage than otherwise, because the water was kept smooth.

A day was spent at this interesting spot in taking bearings and collecting specimens of all kinds. The ships then resumed their route, steering nearly due east away from the land (instead of following the coast line, which here turned to the south), in the direction of the New Siberian Islands; but a dense ice-pack met with on the 22d put a stop to their advance in this direction, and they had to retrace their way, and by the evening of the 23d were again in open water; then, by keeping more to the southward, no more ice was met with up to the mouths of the river Lena, where the little vessel of that name parted company with her larger consort on the night of the 27th, the latter continuing her course toward Behring Strait.

In three days, notwithstanding that there was much time lost in dredging and taking soundings, 360 miles were accomplished, showing how little obstruction there had been by ice, which was, however, seen in greater or less quantities to the north. As they advanced, however, it was necessary to keep to the open channel along the coast, which they had to hug closely, as the strip of water became narrower every hour; yet no serious delay was caused as far as Cape Schelagskoi, which was arrived at on the 6th of September, being still about 500 miles from Behring Strait.

The ice was now found so closely packed, that it was requisite to approach still nearer the coast to find an open channel. Whilst attempting with much difficulty to do this, two large skin boats, of the same build as the Oomiaks of the Eskimos, came off full of natives, the first people that had been seen since leaving Chabarova, about 2,500 miles to the east. These could speak neither Russian nor any other language understood by the Swedes. One boy could count ten in English, showing that they had probably more communication with American whalers than with the Russians. These Tchuktché were found still to use some implements of stone and bone, and their features have an undoubted resemblance to the Mongols of the Old World, and the Eskimos and Indians (?) of the New. Evidently these Tchuktché resemble closely in habits the Eskimos, and preserve like them the contents of the reindeer paunch for food.†

The winter quarters of the "Vega" proved safe, and were in other respects

† At page 385 of "Nordenskjold's Arctic Voyages," he says of the Tchuktches—"a tribe doubtless descended from the Eskimos of Greenland." In my communications with the Eskimos at several positions on the American coast, I was led to believe, from what they told me, that they had migrated from the *West*, and not from the *East*, and therefore the Greenlanders were most probably descended from the Asiatics.

favorable for comfort and health, being so little to the north, that even on the shortest day—21st December—they had four or five hours daylight. Villages of from five to fifteen tents or most friendly Tchuktches studded the coast, from whom reindeer venison and bear's meat were obtained, being no doubt one of the causes why no symptoms of scurvy made their appearance. These people may he called Marine Tchuktches, in contradistinction to the Reindeer Tchuktches, who wander about from place to place with their herds of tame deer, and who supply the former by barter with the skins of this most useful animal, which form their winter dress. ‡

It is to be regretted that here, as elsewhere, where the civilized man goes, the natives have been taught the love of alcohol, which is especially baneful where this demoralizing drink is used as an article of barter, an offense of which I am happy to find Nordenskjöld was not guilty—only giving "a drop now and then to encourage them." The American whalers bring annually large quantities of spirits to this coast, notwithstanding the prohibition of the Russian government.

The "Vega" was liberated from her ice fetters on the 18th July, 1879; passed East Cape at the narrowest part of Behring Strait, and entered the Pacific on the 20th of July, thus completing the northeast passage—a glorious, and in all probability a most useful work, worthy of this distinguished explorer. The wonderful enthusiastic reception that the Swedish Arctic hero has met with, from the time of his reaching Japan until his arrival at Stockholm, the capital of his adopted country, expresses better than any writing can, how well and truly his work is appreciated.

If I may be permitted to express a regret, it is that Nordenskjöld did not sail from Gottenborg ten or twelve days earlier than he did, because there seems little doubt that, had he done so, he would have completed the passage in the summer of 1878. The Kara Sea was certainly navigable ten days before he traversed it, and nearly all the ice met with was in a decayed state, capable of causing little obstruction in deep water. In fact, its decayed state during the latter part of the voyage, was in a great measure the cause of obstruction, because it floated into much shallower water than the undecayed floes would do, and in a less depth than was required to float the "Vega," and thus her advance was obstructed, as was the case with Captain Collinson's vessel in the autumn of 1853, on the somewhat similar low, flat, Arctic shore of America, west of McKenzie River, when making his way from the east toward Behring Strait.

Whilst on the eastward voyage, early in the seasons of 1850 and 1851, no difficulty was found in making a passage either by Collinson or McClure, because at that time of the year the floes were much thicker and larger, and took the ground in deeper water than was required to float their ships, thus leaving a navigable channel between the ice and the shore.—*London Journal of Education.*

‡ Numerous graves with burnt human bones were found. These were covered first with turf, and then with small flat es.

DEATH OF PROF. S. S. HALDEMAN.

Prof. S. S. Haldeman, A. M., the distinguished scientist, a Professor in Pennsylvania University, died at his home at Chickies, Lancaster county, Pa., September 10th. He was born near Columbia, Pa., in 1812, and pursued his studies at Dickinson College until 1830. In 1836 he was chosen an assistant in the New Jersey Geological Survey, and held the same office in the ensuing year in the Pennsylvania Geological Survey. While engaged in this capacity there he discovered the oldest fossil known at that time, viz.: *Scalithus incaris*. In 1851 he was chosen to the chair of natural history in the University of Pennsylvania and held it till 1855, when he entered upon the duties of corresponding professorship in Delaware College, and later in the same year became Professor of Geology and Chemistry at the Agricultural College of Pennsylvania. At the time of his death and for many years before he was the Professor of Comparative Philology in the University of Pennsylvania, and attended and took a prominent part in the recent meeting of the American Philological Association of Philadelphia. He was the author of numerous articles on conchology, entomology and palæontology, and among his principal papers was his Analytic Ornithological Monograph of the Fresh Water Univalve Mollusca, published in 1840 and 1845; Monography du Genre Leploris, published in Paris in 1847, and papers on Linguistic Ethnology, 1849; Zoölogy of the Invertebrate Animals, New York, 1839, and on the Relations of the English and Chinese Languages, published in 1856. His work entitled Analytic Orthography, which consists of investigations into the philosophy of language, obtained for him in England the highest Trevellyan prize in 1858, over eighteen competitors.

PHYSICS.

FRESHET OF JULY 1880 IN THE MISSOURI RIVER.

The high water of July 1880, was the largest body or accumulation of rain-water in the river at any one time in the last twenty-seven years, and yet in the counties of Lincoln and St. Charles it did not reach the ordinary high banks of the river by thirty inches, or the height of the high water of 1876 by twenty-eight inches.

Many were of the opinion that the river did not have capacity to hold the floods coming down, even before it commenced raining between the Des Moines and Missouri Valleys, but when the series in near succession, of unusual heavy rains came at maximum height of flood, the general opinion was that the river would be higher than in the last three decades.

Why, admitting the causes stated, did not the river reach the height of '76 or the greater height of '51?

Simply that none of the snow-water mingled with the flood just past. In 1876 from thirty to forty per cent. of the snow that fell during the winter of 1875 and 1876 and drained into the Upper Mississippi, mingled with that flood, hence higher than the flood of 1880. Again it may be asked, why the flood so destructive above, did not reach the danger line by more than two feet in Lincoln and St. Charles counties? The answer is, the greater capacity of the river, which is from one and three-fourths to two and a fourth miles wide in St. Charles, while at places above it is not half that width. And to this fact may be attributed the breaking of the Sny Levee, avarice crowding it out when reserve room should be left for high water.

Most persons interested in the Mississippi Valley are familiar with its present condition, but the physical changes are forgotten, if ever understood by the masses, and that the change is a matter of general interest, will justify giving some of its causes. Twenty-five years back, or in 1855, very little of the land draining into the Upper Mississippi was improved, say between three and five per cent. At that time the population of Iowa was very small; Minnesota and Wisconsin were almost a wilderness, and the dense forests of those States were unbroken except by the bridle or foot-path of the Indians and very few small clearings on the principal streams. The chief physical changes in the last twenty-five years are the gradual lowering of the high water, the lessening of malarial fevers and the climatic changes of warmer summers and colder winters.

The change of temperature of seasons is generally admitted to be caused by the destruction and cutting and clearing of the forests. The decrease of fevers is owing to the increased cultivation of the land, making it porous and absorbent, and the general drainage of the land as cultivated.

The gradual lowering of maximum high water embodies several causes, the chief of which is the cutting of the timber in the heavy snow-belt in the States of Iowa, Minnesota and Wisconsin, that drains into the Mississippi river. When these forests, that have furnished lumber for the valley and country west of the river for the last twenty years, were intact, the heavy snows were shaded and did not thaw until the spring heat got so strong that nearly all the snow was changed to water in a few days—and swelling the streams and rivers so rapidly, that when emptying into the Mississippi they had the appearance of crested waves. Heavy snows rapidly changed into water, and all, centering in the one channel, resulted in high water, and then such high waters reached the wide lower plateaus along the river, when the season was very wet, or in conjunction with very heavy rains, as happened at intervals of fifteen or twenty years, resulted in overflow. The doing away in chief with this cause has been the work of the lumberman and pioneer for the last twenty-five years, as slowly but surely they have been cutting away the great pineries at a rate varying from one to five per cent. a year, so that at this time not more than twenty-five per cent. of the original forest remains in the tributary snow-belt, and the result is, that as the snow is unshaded, the feeble warmth of early spring sun is admitted, it begins to thaw first slowly, but faster as the warmth increases, so that all the snow unshaded is thawed and passed into the streams and small rivers in March to find rest in the Mississippi the early part of April; and the snow thawing so gradually off the lands cleared that it now makes little perceptible change in the river below Keokuk—a fact well known to river men. The quarter of the snow-belt yet shaded (but gradually diminishing) gets to the river about the first of May, to be shaded by the Missouri about the last of May. This gradual outcome of the snow-water is the chief cause of the gradual decrease of the average high water. Next cause in importance is the increase of the cultivation and draining of the land tributary as the surface is cultivated, the absorption is increased, and the ditches pass off quickly what is not absorbed; and as the streams conveying surplus surface water to the river, the lower emptying will keep out of the way of the upper, and the capacity of the river where one and a half to two miles wide, as it is below Cap au Gris, is sufficient to hold extraordinary rain-floods, as demonstrated in the last. Again, as the surface of the ground is cultivated or cleared the evaporation increases, which is no small matter in the extent of area that drains into the valley, and, lastly, the increase of current. In answer to the theory some persons have, that as the timber is cut off the floods are higher, and particularly refer to some rivers in Europe, let me say that such rivers head in mountains, in which the main channel and tributaries have rapid current, consequently rise and fall very rapidly.

THE PHOTOPHONE.

In May, 1878, Mr. Alexander Graham Bell, well known in connection with the telephone, announced before a scientific society in London, his belief that it would be possible to hear a shadow by interrupting the action of light upon selenium. At the recent meeting of the American Science Association in Boston, Mr. Bell read a paper describing at length his experiments in the production and reproduction of sound by light, and the invention by Mr. Sumner Tainter and himself of an instrument for the purpose.

The influence of light upon the electric conducting power of selenium is well known. Mr. Bell found the electric resistence of some selenium cells of peculiar construction only one-fifteenth as much in the light as in the dark. It occurred to him that all the audible effects obtained in the telephone by variation of the electric current by sound waves, could also be produced by variations of light acting upon selenium; and that with suitable transmitting and receiving apparatus voices might be conveyed without a wire along a line of light.

The fundamental idea on which rests the possibility of producing speech by the action of light is the conception of what Mr. Bell terms an undulatory beam of light in contradistinction to an interrupted beam; meaning by the former a beam that shines continuously, but is subject to rapid changes of intensity.

The apparatus used to give the required undulatory character to light consists of a flexible mirror of silvered mica or thin glass. The speaker's voice is directed against the back of this mirror, as against the diaphragm of a telephone, and the light reflected from it is thereby thrown into corresponding undulations. In his experiments, chiefly with sunlight, Mr. Bell concentrates upon the diaphragm mirror a beam of light, which, after reflection, is again rendered parallel by means of another lens.

The beam proceeding from the transmitter is received at a distant station upon a parabolic reflector, in the center of which is a sensitive selenium cell connected in a local circuit with a battery and telephone. In a recent experiment, Mr. Bell's associate operated the transmitting instrument, which was placed on the top of the Franklin school house, in Washington, about eight hundred feet distant from the receiver, placed in a window of Mr. Bell's laboratory. Through this distance messages were distinctly conveyed by means of light. In his laboratory experiments Mr. Bell finds that articulate speech can be transmitted and reproduced by the light of an oxyhydrogen lamp, and even by the light of a kerosene lamp.

The rapid interruption of the beam of light by a perforated disk gives rise to musical tones, siren fashion. With this apparatus silent motion produces sound, loud musical tones being emitted from the receiver when no sound is made at the transmitter.

The importance of these investigations it is impossible now to estimate. That the photophone can practically take the place of the telephone is not likely, though it is likely to work radical changes in military and other signaling operations. The heliograph, which has proved so useful in recent campaigns in the Afghan country and elsewhere, can now be made to talk orally yet silently over the heads of an enemy or across impassable streams or other low barriers. For rapid communication between distant exploring or surveying stations, the photophone also promises to be serviceable.

Another result of Mr. Bell's researches in this connection is the discovery that many other substances are sensitive to light. He has found this property in gold, silver, platinum, iron, steel, brass, copper, zinc, lead, antimony, German silver, Jenkins' metal, Babbitt's metal, ivory, celluloid, gutta percha, hard rubber, soft vulcanized rubber, papar, parchment, wood, mica, and silvered glass. The only substances found insensible to light are carbon and thin microscopic glass.—*Scientific American.*

DEEP SEA RESEARCHES.

Dr. Carpenter, the great English physicist, has recently published some remarkable results of his elaborate studies of the latest deep sea explorations. The work of the scientific circumnavigation expedition in the Challenger, though completed in 1876, has not until within a few months, if even now, been fully reduced, and some of its most important discoveries are now announced by Dr. Carpenter, its originator. One of the first questions its labors contribute to solve is the depth and configurations of the ocean basins.

The prevailing notion of the sea-beds, Dr. Carpenter shows, needs considerable modification, none of them having been carefully outlined, except that of the North Atlantic when sounded with a view to laying the first Atlantic cable. "The form of the depressed area which lodges the water of the deep ocean," he says, "is rather to be likened to that of a flat waiter or tea tray, surrounded by an elevated and steeply sloping rim, than that of the 'basin' with which it is commonly compared;" and he adds: "The great continental platforms usually rise very abruptly from the margins of the real oceanic depressed areas."

The average depth of the ocean floors is now ascertained to be about 13,000 feet. As the average height of the entire land mass of the globe above sea level is about 1,000 feet, and the sea area about two and three-fourths times that of the land, it follows that the total volume of ocean water is thirty-six times that of the land above the sea-level. These deductions, seemingly unimportant except to the votary of science, are destined perhaps to serve the highest practical purposes of deep sea telegraphy. The intelligence now quarried out of the enormous collection of later ocean researches shows the modern engineer and capitalist the feasibility of depositing a telegraphic cable over almost any part of the ocean's floor, and ought to give new confidence in the success of all such enterprises properly devised and equipped. When it is remembered that at the beginning of this century La Place, the great mathematician, calculated or assumed the average depth of the ocean at four miles (or 8,000 feet more than Dr. Carpenter determines it to be from actual survey), and that La Place's conclusion was the received view among scientists until 1850, or later, we get some idea of the advance made in this branch of terrestrial physics by modern research. Not less interesting is a deduction Dr. Carpenter makes from the deep sea temperature observations in the North Atlantic.

In consequence of the evaporation produced by the long exposure of the equatorial Atlantic current, its water contains such an excess of salt as, in spite of its high temperature, to be specifically heavier than the colder underflows which reach the equator from the opposite Arctic and Antarctic basins; and, consequently, it substitutes itself by gravitation for the colder water to a depth of several hundred fathoms. "Thus it conveys the solar heat downward in such a manner as to make the North Atlantic between the parallels of 20° and 40°, a great reservoir of warmth." The climatic effect of this vertical transfer of equatorial heat is obvious. If the great heat-bearing currents which enter the North Atlantic traversed its bosom as surface currents, they would expend their warmth largely in the high latitudes. But, as their heavy and highly heated volumes in large measure descend to the deeper strata south of the fortieth parallel, then stores of tropical temperature are permanently arrested off our eastern coast, and ultimately made subservient to our climate.—*Nineteenth Century.*

GEOGRAPHY.

ANNUAL ADDRESS BEFORE THE GEOGRAPHICAL SECTION OF THE BRITISH SCIENCE ASSOCIATION, AUG. 26, 1880.

BY GENL. J. H. LEFROY, F. R. S.

In other regions geography was the pioneer of civilization and commerce. Here for the first time she had been outstripped, for the telegraph and the railway had tracked the forest or prairie, and traversed the mountains by paths before unknown to her. Within living memory no traveler known to fame had crossed the American continent from east to west, except Alexander Mackenzie, in 1793. No traveler had reached the American Polar Sea by land except the same illustrious explorer and Samuel Hearne. The British Admiralty had not long before instructed Captain Vancouver to search on the coast of the Pacific for some near communication with a river flowing into or out of the Lake of the Woods. The fabulous Straits of Annian were to be found on maps of the last century. "The sacred fires of Montezuma" were still burning in secluded valleys of Upper California when Her Majesty ascended the throne.

After referring to the memorable expeditions of Franklin and Richardson, of Back, and Simpson and Rae, he proceeded to point out the many agencies of work of late years to open up the continent; the military operations, for example of the United States Government against Mexico; the discovery of the precious metals; the explorations for the Union Pacific and Canada Pacific Railways; international boundary surveys; the geological surveys of the American and Canadian Governments. These had all resulted in a surprising extension of geographical knowledge without any of them having it particularly in view. It was a bold figure of speech of Lord Dufferin's which described the Rocky Mountains in 1877 as being nearly "as full of theodolites as they could hold," but the Dominion Government had spent about three-quarters of a million sterling on explorations or surveys for their railway, and we had only to glance at a recent map to discover nine sovereign States and seven Territories west of the Mississippi, bounded by right lines, which neither war nor diplomacy had determined, laid out like garden-plots, to see that neither Asia nor Africa had unfolded more of their secrets in our times than had the nobler continent where Britain has cast her swarms.

With reference to the survey operations of the Canadian Government in the North-West, where the problem presented was to prepare a vast territory, wholly wanting in conspicuous points, for being laid out in townships of uniform area, and farms of uniform acreage, he said that the law required that the eastern and western boundaries of every township be true astronomical meridians; and that the sphericity of the earth's figure be duly allowed for, so that the northern boundary must be less in measurement than the southern. All lines are required to be gone over twice with chains of unequal length, and the land surveyors are checked by astronomical determinations.

The sources of the Frazer river were first reached in February, 1875, and found in a semi-circular basin, completely closed in by glaciers and high bare peaks, at an elevation of 5,300 feet. The hardy discoverer, Mr. E. W. Jarvis, traveled in the course of that exploration 900 miles on snow-shoes, much of it with the thermometer below the temperature of freezing mercury, and lived for the last three days, as he expresses it, "on the anticipation of a meal at the journey's end." Mr. Jarvis describes how on one occasion, having walked into a hole concealed by snow, the current caught his snow-shoes, turning them upside down, and held him like a vise, so that it required the united efforts of all his party to extricate him.

The final decision of the Canadian Government to adopt Burrard's Inlet for the Pacific terminus of their railway relegated to the domain of pure geography a great deal of knowledge acquired in exploring other lines—explorations in which Messrs. Jarvis, Horetsky, Keefer, and others had displayed remarkable daring and endurance. They had forced their way from the interior to the seacoast, or from the coast to the Peace river, Pine or Yellow Head passes, through country previously unknown, to Port Simpson, to Burke Channel, to the mouth of the Skeena, and to Bute Inlet, so that a region but recently almost a blank on our maps, which John Arrowsmith, our last great authority, left very imperfectly sketched, was now known in great detail, and, he regretted to add, the better known, the less admired. The botany had been reported on by Mr. Macoun, and the geology by Dr. Dawson, *pari passu* with its topography.

A discourse on American geography would be incomplete without reference to the great design of piercing the Isthmus of Panama, with which Count Ferdinand de Lesseps had connected his name. Out of the conflict of about ten competing lines the oldest and the youngest alone survive. The route by Lake Nicaragua appeared possible even to Cortez. It was accurately surveyed nearly seventy years ago, and the estimates, although they have grown alarmingly, are still within practicable limits. It had the preference of the highest authorities in the United States. Its total length would be 180 miles, including 56 miles of lake navigation, with a summit level, to be attained by lockage, of 107½ feet. The Panama route would shorten the canal to one-fourth of this length, and it was a cardinal point with its author to dispense altogether with locks. As they were favored by the presence of Lieutenant Bonaparte Wyse—M. de Lessep's coadjutor—he need say no more, except that the enthusiastic reception given to M. de Lesseps in Swansea, not many weeks ago, was sure evidence that this great industrial center took a keen interest in his project from a commercial point of view; and they might safely leave capitalists, engineers, and diplomatists to fight out their own battle, only concerned that by one route, if not by both, the world might reap in our day the vast benefit it already owed, in another quarter, to his genius and indomitable perseverance.

After referring to other fields of geographical interest, he concluded by saying that when the British Association last met at Swansea a generation had passed away. Of the eminent men then present in office, some half-dozen alone remain, and in the retrospect it was so natural to take, the growth of geographical information stood out in remarkable prominence. Still—

"The cosmographer doth the world survey,"

and finds an illimitable field for the improvement of old, or the acquirement of new, knowledge. Better methods of instruction, better books, and, above all, better maps, are changing the aspect of the study to the young; every traveler who settles one question raises others for his successors, so that "no man can find out the work that God maketh from the beginning to the end." Its perpetual youth was the charm of their science; might it also be his excuse.

A vote of thanks was moved to the President for his admirable address.

Sir Henry Barkly, in moving it, expressed his regret that the section would not have the advantage of Sir Henry Lefroy's presence at any other sitting of the section, he being obliged to leave for London to prepare for his immediate departure to Tasmania, of which he had been appointed Governor. He was sure they all wished him and his family a pleasant and prosperous voyage. [Cheers.]

The motion was seconded by Mr. F. Galton and carried by acclamation.

OTHER PROCEEDINGS.

The President then read some letters of a very interesting character from Mr. Joseph Thomson, received by the Royal Geographical Society's East African Expedition. The following are passages from this correspondence:—

"KAREMA, OR MUSAMWIRA, LAKE TANGANYAKA, March 27, 1880.

"I have failed in my attempt to reach Jendwe by way of the Lukuga and Kabuire. I left Kasegna (or Mtowa) on the 19th of January, with all the confidence of a young lion which had not yet known a reverse, and six weeks after I returned to the same place as meek as a lamb. From the very first I had great difficulties with the men, as they believed I was taking them to Namguena, where they would be eaten up. They tried every means in their power to throw obstacles in my way and retard my movements, two of them deserting near Meketo, and the others threatening to do the same. For six days I continued my course along the Lukuga, in spite of their opposition, but I was then obliged to give in. It flows in a general west-northwest direction to that place, and then about west into the great westerly bend of the Congo, all the way through a most charming valley, with hills rising from 600 to 2,000 feet in height. Above the lake the current is extremely rapid and quite unnavigable for boats or canoes of any description, owing to the rapids and rocks. From Makalumbi I crossed the Lukuga into Urua, and struck southwest for the town of Kiyombo, who is the chief of all the Warna on the eastern side on the Congo. I found out, however, I had only escaped difficulties with my men to fall into ten times worse with the Warna.

They turned out to be the most outrageous scoundrels and thieves I had yet met. It is impossible to convey to you the miserable life we led during the five weeks we were in their country. They had not the slightest acquaintance with traders, and they had no respect for the white man. The chiefs demanded exorbitant mhongo, and made us stop wherever they took the fancy. The people were by no means loth to help themselves by tearing the clothes off the backs of the men, even in crowds. Several times they turned out to fight us. Arrows and spears have been aimed at me within a few feet; at one village a crowd had got hold of one of my men, and I only forced my way in just in time to deflect a descending axe which would have ended his days; and yet we had to show ourselves firm as well as pacific. The slightest accident or blood drawn, and not a soul of us would have escaped. How we ever escaped with our lives I cannot comprehend. Imagine being awakened in the dead of the night in your tent by your blanket being torn from under you, just in time to catch hold of your azimuth compass and to find your watch gone. Such was one of my nights' adventures. Fortunately they got frightened at the watch, and the chief brought it back next day. These facts will give you some faint notion of our troubles. We reached Mtowa on March 10, destitute of almost everything. To my delight, however, I heard that Mr. Hore was expected every day on his way by canoe to the south end of the lake. On the 23d we started, crossed the lake to Kungwe, and reached Karema on the night of the 26th. As we neared the shore we were hailed by the jolly voice of Captain Carter, whom we found gun in hand and bursting with stories of his wonderful adventures in sport and war, keeping us fixed on our seats all night in his tent as he launched them forth. We went over to visit the Belgian international party at their temporary quarters to-day. Captain Carter had his elephant ready to take us across the marsh. Karema is one of the most extraordinary places for a station that could be found on the lake—a wide expanse of marsh, a small village, no shelter for boats, only shallow water dotted with stumps of rock, no room to be got, and natives hostile; far from any line of trade. The party have commenced building forts and walls, digging ditches in regular military fashion. At the table there sat down an Englishman, an Irishman, a Scotchman, a Frenchman, a Belgian and a German, representing five expeditions, and you will doubtless be pleased to learn that of all these (thanks to yourself) the Scotchman, though the smallest, and having to travel through entirely new country, had been the most successful of all. After leaving Karema we had a moderately good voyage across the lake to Jendwe, at which we arrived on the 7th of April. I was much pleased to find everything in good order and the men all in pretty good health. What annoyed me more was the news that my projected route to Kedwa was impassable. Merere had recommenced the war with the Wabehe, and to pass from the one country to the other would be quite impossible. Under the circumstances there was nothing for it but to down helm and run before the wind with all sails set, with the result of landing me on a route which has now often resounded under the iron heel of the English traveler

—nay, has even shaken under the ponderous weight of the civilized elephant. Still, though driven from my projected scheme, my march from Jendwe has not been valueless. Passing around the south end of Tanganyaka along the shore as far as the mouth of the Kilambo, then striking about N. NE. through Ulungu and Fipa, we reached by easy ascents the town of Kapufi, situated in lat. 8 S and long. 32.25 E. Best of all, however, while at this place I had the honor to settle the problem of Lake Hikwa, or rather Likwa, and give it some shape and place in our maps. It has run itself in the hearsay accounts of successive travelers into various protoplasmic shapes, and, will-o'-the-wisp like, danced about on the map to the tunes of various geographers. I, of course, saw only a part of it, but from what I could gather it must be from 60 to 70 miles in length and 15 to 20 in breadth. It lies two days east of Makapuli, in a deep depression of the Lambalimfipa Mountains. A large river called the Mkafa, which rises in Kawendi, and which by its tributaries drains the greater part of Khonongo and Fipa and Mpimbwe, falls into it. I can almost say with certainty that it has no outlet, certainly not any toward the west. The Kilambo rises near Kapufi. I was surprised and pleased to find that my bearings and estimated distances, as laid down on my sketch map every two days, had actually brought me within one or two miles of Tabora as laid down by Speke and Cameron. I can hardly, however, call it anything but a curious coincidence."

"To the Secretary of the Royal Geographical Society.

"ZANZIBAR, July 19.

"Dear Sir—I have the honor and pleasure to inform you of the safe arrival of the Society's expedition at Zanzibar, in all respects in good condition. Chuma, and my second headman, Makatuba, have worked like heroes, and I should, indeed, be but a poor mortal if I did not acknowledge the fact that the success of the expedition has been to a large extent due to them. Indeed, I can claim but little merit, as the men were all imbued with the idea that I was put specially under their care by the Baluya (Dr. Kirk) to be taken carefully and safely round Central Africa, and then returned safely to Dr. Kirk, to whom they considered themselves responsible for my well-being. As I am just following in the wake of this letter, I have not attempted to enter into any details, awaiting more leisure and the advice of competent men before attempting to put much of my work together. My caravan work has been too much to allow of my making any extensive collections in natural history, but I have still been able to gather a few plants and shells by the wayside, which Dr. Kirk thinks will prove to be interesting and valuable. I am now occupied in paying off my men and settling all accounts, previous to my departure for England, which will be by the mail leaving on the 28th.

"Yours obediently,

"JOSEPH THOMSON."

Sir Henry added that any praise of commendation of the young traveler was almost superfluous. The brave and cheerful spirit in which he described his adventures, his singular mastery over men, all probably older than himself, proved that he possessed the elements of a strong and vigorous character, from which a career of great distinction might be anticipated. Among the lessons that might be learned was that we might take a more favorable view of the native African character. That his men should have been so faithful to him in so many difficulties and temptations, and that they should have been amenable to discipline under such trying circumstances spoke as much for them as for his own character and power. Mr. Thomson would reach London in November, when he had no doubt he would receive a most satisfactory reception from the Royal Geographical Society.

The last paper read consisted of notes of a journey to the Eastern Siberia across the Amur and Ussuri, by the Rev. H. Landsall, which gave a highly favorable view of prison life in the penal colonies of Russia. Mr. Landsall received a vote of thanks.

CHARNAY'S EXPLORATIONS IN MEXICO.

[Translated from "L'Exploration."]

Late news from Mexico informs us that our fellow-citizen, Mr. Desiré Charnay has signed a treaty with the Mexican government, whereby he is authorized to undertake his explorations and excavations among the ruins scattered somewhat throughout the Mexican territory. Mr. Charnay has immediately commenced his campaign, and a dispatch announces that he has already succeeded in discovering, not far from Mexico, at a height of 4,000 meters above the level of the sea, some archæological riches, comprising tombs, vases and inscriptions of every kind. We have now some details on the problems to be solved:—

A striking particularity of Central American architecture and its ornamentation, is the resemblance, in many respects, to the styles well known to the ancient world, particularly to Eastern Asia.

According to Mr. Charnay, who has recently traveled in Java, the Mexiean *teocalis* (houses of God) present some characters almost identical with the temples of Java, and of Cambodge, and Mr. Ferguson, who partakes of this opinion, goes so far as to say that the resemblance between the Boro-Budor and the temple of Tochicalo, or between the pyramids of Suku and of Ojaca is too striking to be explained on the supposition of accidental coincidence. The palace of the governor of Uxmal displays some ornaments which have altogether the aspect of Greek designs. Some magnificent vases, reliefs and busts, Greek at least in style, have been found at Ojaca and in other places. At Palenque some *bas-reliefs* have a character decidedly Assyrian; at Izamal the base of a pyramid presents some gigantic figures which recall the Egyptian Sphinxes, and, in a great variety of forms, is also found the artistic spirit of China and India.

To this accumulation and miscellany of styles is attributable the extreme variety of theories projected for explaining the origin of American civilization. The idea of some grand emigration from the old world is contradicted by the fact that the primitive races of Central America had no domestic animals; knew but a single cereal and were wholly ignorant of alphabetical writing as well as the use of iron, although they lived where that mineral could be found in abundance. The conclusion to which each one comes depends on the objects which he has exclusively considered, and thus some persons have pronounced, without hesitation, for an indigenous civilization, while others have discerned the signs of an origin, Jewish, Egyptian, Chinese or Tartar, according as they have been impressed by different analogies. There exists but a single means for disentangling this difficulty, and that is direct exploration. The materials yet exist from which one can derive certain information, but the work done so far has been conducted with so little coherency that we do not know the totality of the materials. In directing, properly, the investigation of these places one can hope that it will be possible to determine the relations of the objects to each other, and to fix approximately so as finally to arrive at the essential points of similitude which may exist between the ancient monuments of Central America and those of the ancient world. The present scope of the expedition comprehends the greater part of Central America, so-called properly, or that part of the continent that extends from the Isthmus of Tehuantepec to the Isthmus of Darien. It is here that the ancient civilization attained its highest degree, and where it has left the most imposing monuments of its grandeur.

Squier inclines to the belief that this is the vast center whence primitive civilization radiated. He regards it as the permanent home of the Toltecs, from whom he derives descendants in the Mayas of Yucatan, the Quiches, the Kachiquels and the Chiapas of Guatemala.

Diego De Landa speaking of the prosperous condition of Guatemala, at the epoch of the conquest, tells us that the whole peninsula seemed to form a continuous city, which expression does not seem to pass for a figure of rhetoric, when we take into account the extraordinary number of monuments scattered over the entire extent of the soil. The expedition, in directing its route by way of Ojaca, will examine the sculptures of Mount Alban and the rich mines of that region. Thence it will return to Milta and examine the ornate and massive constructions which were reproduced, with so much delicacy, in a series of large photographs published by Mr. Charnay in 1863. After having passed some time in the mountainous and almost unexplored district that borders Tehuantepec, it will arrive at Palenque. It is expected that this celebrated religious centre will furnish a rich harvest of inscriptions and *bas-reliefs*. Entering Yucatan the expedition will explore some new regions and will penetrate, if possible, into the mountainous country of the warlike Lacandones. A great interest also attaches to its sojourn among the Mayas, who, but a few years ago, made themselves masters of Yucatan and have, it is pretended, reconstructed the ancient cities with their forts and their temples, and have revived many of the customs, laws and idolatrous rites of their ancestors. Every effort will be made to find some traces, if any yet remain, of the tribes that preceded the Astecs—that is to say, the Otomes—the Chechimecs, and the Olmecs and even a people yet more ancient, of whom sufficient vestiges have been discovered to establish the truth of their existence. Don Manuel Orozco believes that the inhabitants of Mexico comprehend about 120 tribes, and this number must have been more considerable in primitive times. Following the same authority, more than sixty idioms have perished within the limits of the Mexican Republic, and according to Frederic von Hellwald it is very improbable that the inhabitants of the country, in the most remote period, formed a homogeneous population. Of some of the most ancient inhabitants, to whom is attached considerable ethnographic importance, we possess only the names and some traditions of little dependence. Among these tribes are the Olmecs, who, according to the legend, subdued the gigantic race of Quinames and of the Otomes, or Hia Hia, the language of whom has been perpetuated over a large part of Mexico until the present day. The expedition will make every research that can conduce to the object to be attained. It will excavate the tombs and the sacred marshes in which, it is supposed, the faithful have cast their offerings.

J. F.

ITALIAN EXPEDITION IN THE SOUDAN.

Further letters from Dr. Matteucci give some interesting details of the observations made by him in Kerdofan during the march of the expedition under Prince Borghese. In Kordofan, he says, water is as dear as the wine of Barletta. In the rainy season, however, things are different; from June to September almost every inch of the country is covered with water, when if one may not die of thirst, there is a chance of his dying of malaria. Vegetation along the line of march of the expedition was as melancholy and infertile as it could well be; stunted skeleton acacias alternating with a few euphorbias in constant monotony; neither mountains nor hills, and not even plains. In Kordofan the ground presents continuous undulations, no doubt in consequence of the geological formation of the soil, which is a bottom of sand slightly mixed with peroxide of iron. The water of the rainy season is husbanded in wells, but so valuable is it that the expedition had often to force the natives to give them access to these wells.

At one station they found forty wells dug and others in process of being made. When the expedition arrived they found that the Arabs had closed up these wells by means of thorny branches, and had they not used force the whole expedition would have died of thirst.

Kordofan is about 600 meters above the level of the sea, and 380 above that of the Nile. Not a river, not a torrent, not a brook waters this immense territory, which is about 500 miles long and a little less broad. The mean temperature is not less than 92° At the surface the ground is so sandy that animals on the march sink io a depth of thirty centimeters. The rains are irregular and never abundant. Some years ago there were no wells in Kordofan; the want of water was not felt, for the natives in the rainy season, collected the water in large reservoirs, and a sufficient quantity was found in them at each station and village. But the seasons even in Africa, tend to change. Eight years ago there was no rainy season in Kordofan, and for several months the people feared they would all die öf thirst. Then they thought of digging wells which gave very good results. Everywhere water was found at a depth of twenty inches. But things have sadly changed during the past eight years, and now, instead of finding water at a depth of twenty inches, it is often not found at a depth of 100 feet. In all the wells Dr. Matteucci found the following succession or strata: From fifty to thirty meters of depth, sand with traces of sulphate of lime; above thirty extends the granite, with a great abundance of quartz in proportion to feldspar and mica. The granite mass rarely extends one meter in thickness, and above is again found the sand. El Obeid, from which Dr. Matteucci writes, is a town of 50,000 inhabitants; there are no Europeans but many Arab traders. Most of the people are natives of Kordofan or Dartur. It is a very lively town, as it is the center of the trade in gum, ostrich feathers and tamarinds. The houses, with the exception of the Governor's, are of straw or earth. In the neighborhood of El Obeid two Roman Catholic missionaries, who seem to reside in the town, have established a station occupied by their married converts. It is a small village of only thirty houses and thirty small families. But Dr. Matteucci regards it as the most satisfactory result yet achieved by the Roman Catholic mission, whose headquarters are at Khartoum. Malbes is the name of the village, and it ls situated in a territory where there are no Mussulman proselytes. Dr. Matteucci is of opinion that such agricultural colonies would make a far deeper impression on the surrounding heathen than any amount of preaching, and strongly advises the mission to develop the system.

THE DUTCH ARCTIC EXPEDITION.

On the third of June the little sailing vessel *Willem Barents* set out from Holland for the third time, to undertake a new exploration in the Arctic seas.

The staff of the expedition, under the command of M. H. Van Broekhuysen, is composed of Lieuts. A. J. Frackers, S. A. Lanne, J. M. Calmeyer and Dr. N. Hamaker, surgeon.

The crew includes a carpenter, a foreman, cook, five sailors and a cabin-boy. In addition, there is on board a marine painter of great talent, M. Louis Apol, who is commissioned to paint among other things a large picture of the Glacial sea for a panorama, which is now being prepared at Amsterdam. The officers, Van Broekhuysen and Calmeyer, the carpenter, Latjens, the sailor, Westerning, and the cabin-boy, Klaas Mantel, were on the *Willem Barents* in a previous voyage. Although a professional naturalist does not accompany the expedition, zoölogical researches will not, for that reason, be neglected.

The object of this third expedition does not differ essentially from that of the two others. It is, in the first place, an enterprise for practice; in the second place, it is a patriotic undertaking, its object being to continue the work of its ancestors and to render homage to their memory by raising modest monuments in the places which they have discovered and which bear their names; lastly, it does not lose sight of the interests of science, for it is intended to continue researches, discoveries, the operations of sounding, the meteorological and magnetic observations so successfully inaugurated by other expeditions, and, if circumstances will permit, the explorations will be pushed in the direction of Francis Joseph Land, at Barents Harbor, and of the Kara Sea, or in any other direction that is expedient.

The *Willem Barents* left Amsterdam on the third of June by the new canal which connects this city with the North Sea. No news has yet been received from her.

HERMENEUTICS.

THE BIBLE AND SCIENCE.

BY PROF. S. H. TROWBRIDGE, GLASGOW, MO.

The first and chief object of Scripture is to teach man his destiny and his relations and duties to God and his fellow men. While we recognize it to be man's first and highest duty to study the Bible with this end in view, we see nothing irreverent—but rather a privilege and duty—in studying it secondarily, as an exponent of the purest history, rhetoric, literature, morality, principles of practical life, and also as a text-book of science.

It is generally agreed that the Bible was not intended to teach science; and assuredly it was not primarily. But if we study it as a teacher of science we shall find that it yields us no inconsiderable information; and the more we search it for this purpose the more of brilliant and instructive scientific allusion shall we find lurking in it everywhere. And there is no danger that the correctly interpreted Word of God will mislead us into false science.

While we admit that physical science, strictly, has to deal only with physical facts, and Scripture has for its object to teach man the plan of salvation through Jesus Christ, we would allow the widest range in a prescription of the legitimate sphere of each. Let the Bible student study nature to gain a more complete understanding of Scripture, and let the scientist study the Bible for clearer light upon the phenomena of nature. Yet due allowance must be made for the teachings of each out of his special line of study. His authority should be measured by knowledge and reason and not by dogmatic statement. The province of each—which is too often forgotten—is to teach *truth* and not to establish pet theories. The theologian *may* give us very poor science, and the scientist *may* give us very poor theology, and there is no lack of evidence that they actually *do;* but we must admit that the field of each is open to the other. Each of the revelations of God to man must be studied in the light of the other; and we dare to affirm that neither can be comprehended in all its fullness and richness without illumination from the other.

There is no conflict, there is no possibility of conflict, between the Bible and science. That many of the interpretations and theories of reputed scientific men are not in harmony with the teachings of Scripture, is fully admitted. On the other hand, it must be admitted that many of the interpretations of Scripture by Bible students are not in harmony with the revelations of science. We must distinguish carefully between *our understanding* of these two revelations and the *correct* understanding of them There is no less reverence than truth in the statement that either may be misinterpreted. But, true as this is on minor points, we have the authority of the sacred Word for it that no *honest* searcher for truth can fail to find in that word light which, if followed, will lead him to salvation and heaven.

That there is no conflict, but the greatest harmony and co-operation between science and Scripture, allow a few illustrations from the many.

Only a few years ago it was almost universally accepted that the earth was only about 6,000 years old. But the discoveries of the geologist led him to conclude that the successive strata of rocks, each containing remains of animals entirely distinct from those in other strata, could not have been deposited in so short a time. And, by carefully studying the statements of Genesis and comparing them with the rocks, it was plainly seen that the Bible record had been misinterpreted; and now friends and foes of the Bible alike agree that the age of the world is indefinitely long, and that the six days of creation were not literal days but periods of vast duration.

For a similar reason, the present estimate of the age of man upon the earth is, by many, being indefinitely lengthened.

It is generally believed that all the races of men sprung from one common pair, in Asia Minor, about 4,000 years before Christ. Yet ethnologists find it extremely difficult to understand how this can be, when apparently unmistakable evidences of man are found in the farthest extremities of the earth, which bear witness that they have a greater antiquity than that assigned to Adam. The earliest records of men bearing on this point—which date back from 3,000 to 5,000 years—show that the different races had then as marked peculiarities of form, features and color as they now have. Hence *some* are beginning to conclude that, on this point too, we have misinterpreted the Bible; and, on scrutinizing more closely the Scripture record, they decide—as does Agassiz—that the narrative in Genesis is a history of the origin of only one of the varieties of the human race.

Isaiah prophesied: "And the Lord shall utterly destroy the tongue of the Egyptian sea." Surveyors for the Suez ship canal route learned the fact, unknown up to that time, that a bar or slight upheaval had become sufficiently elevated to cut off a large narrow body of water from the north end of the Red Sea, to which they saw evidence that it was originally joined. This elevation, which is about ten miles wide, was probably below the surface of the sea at the time Israel escaped from the bondage of Egypt; and, from the best evidence accessible, it is in the immediate vicinity of the locality in which the Israelites crossed, and possibly furnished a highway for them. Thus science throws light upon the Bible.

Christ spoke in parables because the prejudices of most of his hearers would not allow them to profit by undisguised truth. But when his disciples *wanted to understand* the parables, he clearly explained them. There are many obscure references in the Bible to various points of physical science. If they were expressed distinctly the world would not be prepared to receive them. Scientists are, through the study of nature, as we have seen, learning to see the force of some of them. But many scientists, like the most of Christ's hearers, do not try to understand them, they seem to ignore them. Now, if we should as earnestly desire to comprehend these dark allusions as the disciples did to understand Christ's parables, would not the spirit—which Christ promised should teach us all things, and which directs us even in the temporal affairs of life—be given to enable us to comprehend the truths of science through the teachings of Scripture?

Many conclusions have been reached by students of nature which, if the Bible had been accepted as an instructor of science, might probably have been reached much earlier. According to the Nebular hypothesis, the earth was once in a molten state covered with a thin crust, aud this was so completely covered with water that no land appeared. Afterward, as the earth contracted, the crust sunk in some places and was thrust up in others, thus making mountains separated by valleys filled with water. This is clearly explained in Psalm CIV, where it reads; "Thou coverest the earth with the deep as with a garment; the waters stood above the mountains. At thy rebuke they fled, at the voice of thy thunder (doubtless the rumbling thunder of an earthquake) they hasted away unto the place which thou hast founded for them."

It has been known for a brief term of years that there are wind currents from the poles to the equator and that counter currents carry the air back to the poles again. But not till more recently has it been known that thunder showers, storms extending across half a continent, and cyclones, are rotary, and that their winds move in a whirling, spiral motion toward the center. Both of these facts of recent science were, long ago, brought to light by the Preacher in these words: The wind goeth toward the south and turneth again unto the north; it whirleth about continually, and the wind returneth again according to its circuits.

In the very next verse we read: "All the rivers run into the sea, yet the sea is not full; unto the place from whence the rivers come thence they return again." David says: "The waters go up by the mountains, they go down by the valleys." Another passage reads: "He causeth the vapors to ascend from the ends of the earth; he maketh lightning for the rain; he bringeth the wind out of his treasuries." Physicists, by laborious research, have learned that water is taken up in the atmosphere in a state of vapor, carried by the winds to the cold summit of mountains, there precipitated in rain, and brought down by the valleys to the sea again. But they have learned, with all their study, little more than was plainly told them in the Bible thousands of years ago.

It is now well known that the earth is the food of plants, and is in these so elaborated that they become food for animals. These plants and animals which feed upon other plants too coarse for us, furnish food for men. Thus science has reached the conclusion that the food which forms man comes from the earth, and the earth is his nourishing mother. But 3,000 years before we learned this, David said: "My substance was not hid from thee when I was made in secret and curiously wrought in the lowest parts of the earth. Thine eye did see my substance yet being unperfect."

After Franklin determined that lightning was electricity, and had invented the lightning rod, the beautiful idea was finally grasped that every pointed blade of grass, and leaf, and twig, directed sky-ward, was practically a lightning rod, and was continually conveying electricity from the clouds. But long ages ago we were told by God's own word that *He* maketh "a way for the lightning of thunder."

Recent scientists claim credit for discovering what they call the law of evolution. But it has been well suggested that the doctrine of evolution was first advanced in these time-honored words: "The thing that hath been is that which shall be; and that which is done is that which shall be done; and there is no new thing under the sun."

The sun's heat is supposed to be the physical cause of the centrifugal force which keeps the members of the solar system from falling into that luminary. The Nebular hypothesis involves the supposition that the sun is losing its heat. Hence it must be losing its repulsive force; and the necessary result would be that planets, as they revolve around the sun, would slowly fall toward it, their orbits making a gradually diminished spiral till they finally reach the sun. The arresting of the enormous motion thus acquired would, it is supposed, produce sufficient heat to melt the whole mass and even dispel it into a Nebulous state again. Is not this quite consistent with the announcement of Scripture: "All the heat of heaven shall be dissolved, and the heavens shall be rolled together like a scroll; and all the host shall fall down as the leaf falleth from the vine, and as the falling fig from the fig tree;" and "the elements shall melt with fervent heat; the earth also and the works that are therein shall be burnt up."

BOOK NOTICES.

THE NEW TEXT BOOK OF PHYSICS: By Le Roy C. Cooley, Ph. D.: pp. 317, 12 mo.: Chas. Scribner's Sons, New York, 1880.

Doctor Cooley is Professor of Physics and Chemistry in Vassar College, and this little work is the result of his experience as a teacher and an investigator. It is really a second edition of his Text Book of Natural Philosophy, published in 1868. But he has so materially changed the tone of the work, by the introduction of the "principle of energy" into all departments, that he has deemed it proper to give it a new and distinctive title. At the same time much new matter has been introduced, bringing the work fully down to the most advanced scientific applications of electricity and the most recent discoveries in other departments of science.

The work seems to be thoroughly systematized and adapted to the wants of both teachers and pupils. A very noticeable feature is the summing of principal topics and problems at the close of each chapter, for use in reviewing. The illustrations are numerous and new, and the publishers have bestowed much pains upon the mechanical part of the work.

THE UNITED STATES GOVERNMENT; By George N. Lamphere: pp. 297, Octavo: J. B. Lippincott & Co., Philadelphia, Pa., 1880; $3.

The author of this valuable work has for several years occupied a position in the treasury department at Washington, which has given him excellent facilities for familiarizing himself with the workings of the various branches of the government, even in their minutest details, and the information thus gained he imparts to his readers through the pages of the above named volume, in a clear and succinct manner. He has exercised excellent judgment in selecting and arranging the subjects treated, and has thereby compiled a work which contains interesting and useful information for all classes. Beginning with the Declaration of Independence and the Constitution of the United States, with its amendments, he takes up and describes fully the Legislative, Executive and Judiciary departments with all their sub-divisions, including the Department of State, of the Treasury, War, Navy, Interior, Post Office, Justice and Agriculture, the duties of all the principal officers, the organization of their offices, the manner of procedure in the different bureaus, the rules and regulations of the various branches, the origin and history of each department, the pay of officers, fees allowed and a multitude of facts on all points connected with the manner of transacting government business, far too numerous to be mentioned here.

To give an idea of the scope of the work, we will say that over one hundred pages are devoted to a description of the Treasury department and the duties of the various auditors; sixty to the War and Navy departments; nearly forty to the Interior department, etc.

It will be quite a surprise to most readers to obtain an adequate idea of the magnitude of the details and operations of the government offices as described in this work, and to be informed that they can learn more from it by a careful perusal, which might occupy a few hours, than they could in many months of constant daily investigation in Washington City.

Such a book is of great value to all classes of citizens, for every one has business with the departments which can be transacted just as well by direct correspondence as through an agent or attorney, did the applicant know whom to address. It would be a good text book for the higher classes in our schools, and if kept abreast of the changes in the different departments by means of successive editions, even congressmen and the officers in the different departments, themselves, would find it an important book of reference.

ADAMS' SYNCHRONOLOGICAL CHART OF HISTORY: By S. C. Adams; Published by Jay Andrews & Co., Chicago. For sale at Kansas City, by Rev. J. S. Card, $15.75.

In these days of object teaching, nothing could be more apropos than the introduction of this work; a chart upon which in one picture is shown the history of the world from B. C. 4004 to A. D. 1878. It is a chromo-lithograph, over twenty feet long and twenty-eight inches wide, yet so folded as to be as easily handled as an atlas, each fold turning over like the leaf of a book; or the whole, or any desired portion, can be spread out at a time for examination.

The length of the chart is divided by perpendicular lines into the fifty-nine centuries and their decades; across these century spaces, pass from left to right, colored lines or streams that represent the different historic nations (and lives of the patriarchs), and change their color to indicate every change of rulers; these streams divide, sub-divide, unite or disappear according to the record of the nation represented; thus every nation with its consecutive rulers and all the leading facts of history are placed upon a fixed scale and presented to the eye in their proper relations as to time, just as geographically a map locates towns, rivers, and countries. Meridians intersect places of the same longitude, in the same manner that century and decade lines on this chart mark contemporaneous nations, rulers and events.

The origin of nations, their grand march through the centuries, and their final overthrow, are prominent features, while the confused mass of dates and events that ususlly comprise our knowledge of history, is so sifted and synchronized, so lighted with colors, models and illustrations, that the centuries of the past seem transformed into individual realities, marked with their peculiar characteristics. The plan of the chart is so simple that children can readily understand it, and so comprehensive that it is in itself a historical cyclopædia for the mature scholar.

So far as we know, this is the most comprehensive and complete work of the kind ever published, and as such it has received the commendations of some of the best scholars in the country, like Prof. McCloskie, Wendell Phillips, Gen. Noyes and Pres. C. H. Payne, D. D., all of whom concur in attributing to it correctness, convenience, and condensation of knowledge to a degree unsurpassed by any other work.

For the use of teachers, students, writers, and for the home circle, nothing equal to it has ever come under our observation. A key, comprising over fifty pages octavo, accompanies each chart, and gives full explanations of the progress of events in each century.

Ray's New Higher Arithmetic: By Joseph Ray, M. D.: pp. 408, 12 mo.: Van Antwerp, Bragg & Co., Cincinnati and New York, 1880.

While Doctor Ray's name remains upon the title page of this work, it has been so thoroughly changed by the late revision that it is really almost a new book, and should properly be credited to other sources. The complete revision was performed by our own fellow citizen, Professor J. M. Greenwood, to whom the publishers freely express their obligations. Nearly every chapter has been rewritten and much new and original matter has been introduced, and all obsolete matter has been discarded. The result is that it is thoroughly modernized and practical, and just such a guide as the older scholars in the schools need to fit them for the ordinary avocations of business life. At the same time it is so arranged and graded as to fit the student who wishes to do so to enter easily upon a course of higher mathematics. Prof. Greenwood is entitled to and has received the highest commendations for the faithfulness and capability he has displayed in this work.

The True Story of the Exodus of Israel, compiled by Francis H. Underwood, 12mo., pp. 260. Boston, Lee & Shepard, $1.50.

The positive declarations of Dr. Brugsch-Bey in regard to the route of the children of Israel in escaping from Egypt, not by crossing the Red Sea, but by passing northwardly far above the upper end of the Red Sea, between the Mediterranean Sea and what was anciently known as Lake Serbonis, on the flat shores of which the disaster to the Egyptians occurred; thence abruptly turning southwardly at the eastern extremity of the last named lake and reaching Elim, in Palestine, by way of the bitter lakes of Suez and the eastern shore of the Gulf of Suez, have aroused quite a spirit of investigation and inquiry among Bible readers, as well as most other classes of readers, and the compilation prepared by Mr. Underwood from his costly volumes ($12,00) will be gladly received.

It must not, however, be supposed that this question alone is discussed by the editor. He has very carefully extracted from these volumes a large amount of important information upon the origin of the Ancient Egyptians; the division of the country; the chronology of the pharaonic history; the early dynasties; art and architecture; Semites and Egyptians; the Pharaoh of the Oppression and of the Exodus, and finally the memoir upon the Exodus read by Dr. Brugsch-Bey before the International Congress of Orientalists in London, September 17, 1874.

Dr. Brugsch-Bey has spent some thirty years in Egypt, and has devoted most of his time to explanations of ancient localities, roads, ruins, monuments and other relics of the earliest times, and has thus become an excellent authority on Oriental history. Still, while his conclusions seem to the reader to be based on correct data, and supported by many facts of modern history, they are not universally accepted by all travelers, nor are his claims to absolute correctness in hieroglyphical translation admitted without dispute by all scholars.

Mr. Greville Chester, who was sent to Egypt by the Palestine Exploration Committee of the Royal Geographical Society, is reported to have discovered that the geographical and physical features of the Serbonis are in actual confl ct with Dr. Brugsch's theory, while the well known scholar, Prof. G. Seyffarth, in his article upon Egyptian Theology, declares that Brugsch's knowledge of the Egyptian language is very defective and that he is totally ignorant of the Hebrew.

Leaving such questions, however, to be settled by still closer investigations, it cannot be gainsaid that Mr. Underwood's book is one that contains much that is new to most readers nor that it will stimulate not only geographical exploration, but also Egyptological study from a new and powerful cause.

OTHER PUBLICATIONS RECEIVED.

Report to the Trustees of the James Lick Trust, of Observations made on Mt. Hamilton, with reference to the location of the Lick Observatory, by S. W. Burnham. The Microscopist's Annual, for 1879, with useful tables rules, formulæ and memoranda; Industrial Publication Company, 25 cents. Legal Rights of Children, by S. M. Wilcox, published by U. S. Bureau of Education. Progress of Western Education in China and Siam, and Vacation Colonies for Sickly School Children, published by same. The Western Farmer of America, a free trade tract, by Augustus Mongredien, London, published by Cassell, Petter & Galpin, N. Y. Amended Charter and By-Laws of the Missouri Historical Society, 1880. St. Joseph Medical and Surgical Reporter, Vol. 1, No. 3; J. P. Chesney, M. D.; $1.00 per annum. Daily Programmes of the American Association for the Advancement of Science, F. W. Putnam, Sec.

SCIENTIFIC MISCELLANY.

PRACTICAL FORMULAS.

The following are kindly communicated by Mr. Robert W. Gardner, of this city:

AROMATIC MOUTH WASH.

Tincture of rhatany	4 ounces.
Tincture of cinchona, compound	2 "
Tannin	24 grains.
Soap	80 "
Simple syrup	2 ounces.
Oil of wintergreen, and Oil of Sassafras, of each	8 drops.

DANDRUFF ERADICATOR.

Tincture of cinchona, simple	1 ounce.
Solution of potassa	2 drachms.
Salt of tartar	1 drachm.
Cologne water	1 ounce.
Water, sufficient to make	8 ounces.

Apply to the head twice or thrice a week.

COUNTER IRRITANT EMBROCATION.

Sweet oil	2 ounces.
Rectified oil of amber	1 ounce.
Oil of cloves	1 drachm.

For whooping-cough and bronchitis. To be applied over the shoulder blades, well rubbed in.

NEW MOWN HAY COLOGNE.

Extract of new mown hay	2 ounces.
Cologne spirit	12 "
Imperial cologne	1 pint.
Extract of patchouly	4 drachms.
Water	8 ounces.

Mix, and filter.

VIOLET COLOGNE.

Extract of violet	2 ounces.
Tincture of musk	4 drachms.
Otto of rose	2 drops.
Cologne spirit	12 ounces.
Water	8½ ounces.
Tincture of orris root	1 ounce.
Carbonate of magnesia	1 drachm.

Mix, shake, and filter till perfectly clear.

RUM AND QUININE HAIR TONIC.

Tincture of red cinchona	3 ounces.
Glycerine	1 ounce.
Jamaica rum	1 "
Tannin	½ drachm.
Imperial cologne, enough to make	9 ounces.

Mix, and if necessary, filter through carbonate of magnesia to obtain it clear. An excellent tonic; to be applied twice a day, rubbing it well into the scalp.

KISSINGEN WATER.

Carbonate of soda	30 grains.
Chloride of sodium	4 ounces
Phosphate of Soda	6 grains.
Sulphate of soda	4 scruples.
Sulphate of magnesia	1 ounce.
Carbonate of Magnesia	100 grains.
Carbonate of lime	140 "
Phosphate of lime	100 "
Muriate of ammonia	2 "

Mix in two pints of water, and add

Tartrate of iron and potassa	20 "
Dissolved in water	2 ounces.
Water	1 gallon.

Charge the mixture slightly with carbonic acid gas, and let it stand over night. Then filter, make up to five gallons, and charge to a pressure of ninety pounds. —*Druggists' Circular.*

A VALUABLE DISCOVERY.

The process, devised by Mr. Bower and perfected by his son, accomplishes the object of protecting the surface of iron, and at the same time produces a beautiful French gray tint, which obviates the necessity of painting the articles treated. The process, which is not secret, consists in heating the articles to be coated in a closed chamber by means of carbonic oxide, heated air being made to enter the chamber for the double purpose of burning the gas and for combining with iron. The excess of air after burning the carbonic oxide gas, combines with the iron, forming first the magnetic oxide and then the hydrated sesquioxide, or common iron rust. By shutting off the supply of air until only enough is admitted to turn the carbonic oxide, the rust is converted into a magnetic oxide. The process is repeated until the film is sufficiently thick for the purpose of protection. The application of this invention has been undertaken on a large scale, the chamber where the oxidation is now carried on being large enough to contain about a ton of miscellaneous articles.

EDITORIAL NOTES.

A LETTER has been received from Prof. E. A. Popenoe, Secretary of the Kansas Academy of Science, in reference to the coming annual meeting, which will be held at Topeka the second week in November. The academy has sustained severe losses in its membership in the removal by death of Profs. Mudge, Bardwell, Fraser and Kedzie, all of whom have been enthusiastic workers in the society. From the very first Prof. Mudge had sustained the most active relations to the academy. He was the first and last President, and his papers have nearly all been based on original observation, and have formed the most valuable acquisitions to science. Such men are good enough for any age or country, and make the world better by living in it. The academy feels the loss of these active workers severely, but is hoping to have a successful meeting at Topeka, and to send forth a creditable volume of Transactions next spring. The committee on programme will be glad to hear from scientific men in the State, who have anything new to offer in the way of observations or investigations.

THE Boston meeting of the American Association for the Advancement of Science, is spoken of by all returning members, as well as by many of the scientific magazines, as a most interesting and enjoyable one and will long be remembered with pleasure by those who were present.

THE Missouri River Improvement Association held a meeting in this city on Sept. 21st and 22d, which was attended by delegates from Kansas, Nebraska and Missouri, the object being to arouse an interest in the matter of increased facilities for transporting the products of the New West to market and to obtain congressional assistance.

Many of the very best business men of these States were present, and doubtless their action will have the final effect desired. The railroads have opened the country, but are unable to do all the freighting. This movement is not intended to injure them, nor is it a local matter. The whole Northwest is interested in the movement, from Fort Benton to St. Louis. Col. R. T. Van Horn was elected permanent President, and W. H. Miller, Secretary, with Vice-Presidents from all the prominent cities of the above named States.

AN observer need go no farther than the the Kansas City and Bismarck Fairs to learn by their immense exhibits of minerals, cereals, vegetables, animals and machinery, what this region of country is doing in this stage of the world's history, while such exhibits of fossils as those of Professor Snow at Bismarck, and of Sidney Hare, here, tell the story of animal or vegetable life in the remote past, before man's influence upon passing events was felt.

PROF. T. BERRY SMITH, who has furnished several good articles for the REVIEW within the past year, has received the position of Professor of Natural Science, etc., in the Louisiana, (Mo.,) College. Besides being an excellent teacher, Prof. Berry is a writer of ability and taste.

REV. MR. CARD, general agent for Adams' Synchronological Chart of history, which is described in full on page 378 of this issue of the REVIEW, has concluded to make Kansas City his home hereafter, and to devote himself to building up a general subscription book business. He has other valuable works, and expects to employ a number of agents both in the city and the surrounding country.

WE are in receipt of the Proceedings of the Saratoga meeting of the American Association for the Advancement of Science, published by Permanent Secretary, Prof. F. W. Putnam. This volume, comprising five hundred and seventy-two pages octavo, is mostly made up of papers read at that meeting, though not more than half of those presented were published.

THE following are the contents of the *Popular Science Monthly* for October: Fashion in Deformity, by Prof. W. H. Flower, F. R. S., (illustrated); Coöperation in England, by George Iles; Modern Aspects of the Life Question, by Prof. George F. Barker; The Australian Ornithorhynchus, (illustrated); The mysterious Sounds of Nature, by Robert Springer; The English Precursors of Newton, II; Criticisms Corrected, by Herbert Spencer. I. Tait and Kirkman; India-rubber Industries, by Thomas Bolas, (illustrated;) On the Production of Sound by Light, by Alexander Graham Bell; Education as an Aid to the Health of Women, by Elizabeth Cumings; On the Destruction of Infectious Germs, by Dr. A. Wernich; Possible Efficiency of Heat engines, by Prof. W. A. Anthony; Sketch of George Boole, (with portrait); Editor's Table; Literary Notices; Popular Miscellany; Notes.

THE *Atlantic* for November will contain the first installment of Mr. James's new story, The Portrait of a Lady; and a timely paper (with reference to the recent death of General Myer, and the weather department) on the Future of Weather Prophecy, by Prof. N. S. Shaler. There will be contributions by Miss Preston, Mr. Aldrich, Mr. Lathrop (on the Concord School of Philosophy), with many essays and criticisms.

AMONG the notes on current scientific subjects in the *American Naturalist*, those of Prof. Otis T. Mason, of Columbia College, Washington, D. C., upon Anthropology, are always carefully and discriminately made, causing them to be a marked feature of that interesting journal.

THE articles in the *North American Review* most likely to be of interest to scientific readers, are The Success of the Electric Light, by Thomas A. Edison; The Ruins of Central America, Part II, by Desiré Charay, and Recent Progress in Astronomy, by Prof. E. S. Holden.

THE *Scientific American* raises the question of the safety of New York and Brooklyn in case of an attack by foreign powers, urging that with the most improved modern ordnance a war vessel can throw shot and shell into both cities from a distance of eleven miles and be entirely out of range of any gun now defending the harbor.

The contents of *Harper's Magazine* for October, 1880, are as follows: The Ascent of Fujiyama—C. F. Gordon-Cumming; Art-Needlework—Lucretia P. Hale; Keats: a Sonnet—John Tabb; Reminiscences of John James Audubon—Thomas M. Brewer (with two illustrations); A Romance of the Hebrides—Amelia E. Barr (with five illustrations); An Autumn Holiday—Sarah O. Jewett (with four illustrations); A Demon-Hunt with St. Hubert in Touraine—M. D. Conway (with nine illustrations); Does Farming Pay? A Poem—Henry S. Goodale (with six illustrations); The Metropolis of the Prairies—A. A. Hayes, Jr. (with twenty-two illustrations; White Wings: a Yachting Romance—William Black (with two illustrations); The Throckmortons. A Story—Mary N. Prescott; Some Peculiarities of Turkish Politics; Washington Square. Part IV—Henry James, Jr; Is It all There Still? A Poem—Z. B. Gustafson; "Bad Peppers." A Story—George Parsons Lathrop; A Buddhist Vision. A Poem—Francis L. Mace; Modern Bee Culture—M. Howland; Morning and Evening by the Sea. A Poem—James T. Fields; The "Sophia Walker"—Captain John Codman; Editor's Easy Chair; Editor's Literary Record; Editor's Historical Record; Editor's Drawer.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. NOVEMBER, 1880. NO. 7.

METEOROLOGY.

METEOROLOGY AND THE SIGNAL SERVICE.

I.

The death of Gen. Myer, the late Chief of the Signal Service, and the necessity of providing a competent successor, have drawn public attention to the Signal Bureau and to the details of the organization.

The work of the Signal Corps during the late war is well known, but the manner in which the meteorological division of the service, as now constituted, came into existence and under control of the War Department, is not so generally known; and, as the paternity of the work is claimed by several persons, it is believed that the following compilation from official papers upon the subject will be of service in giving credit where it is properly due.

On December 8, 1869, Prof. I. A. Lapham, of Milwaukee, Wisconsin, who had been for years a persistent advocate of the importance of some national system of weather reports, in which the telegraph was to play an important part, addressed the following memorial to the Hon. H. E. Paine, member of the House of Representatives from Wisconsin. The memorial was accompanied by a list of disasters upon the lakes, making thirty pages of printed matter, of which the summary only is given in this paper :

MEMORIAL OF PROF. I. A. LAPHAM, OF MILWAUKEE, WIS.

"Not only does the interest of commerce and navigation, but also that of humanity itself, demand that something should be done, if possible, to prevent the fearful loss of life and property on our great lakes, such as has recently filled so many newspaper columns with their appalling details. If we could have even a few hours' notice of the approach of the great storms that bring these calamities upon us, much of their mischief might be avoided. The endeavor to predict the occurrence of storms has been attempted in England, by the late Captain Fitz-Roy, and in France, by LeVerrier, the astronomer; with what success will appear from the following extracts:

"On the 2d of December, 1863, during the day-time, I received two dispatches, stating that a severe storm was about to traverse France," writes the President of the Toulon Chamber of Commerce to M. LeVerrier; "they were published and posted up immediately, and the merchant vessels in the roadstead had time to provide, and did provide, against all risks. The maritime prefecture, on its behalf, directed all officers who were on shore to hasten on board their vessels. The storm burst forth with all its fury about half-past three o'clock in the afternoon. The first telegram sent on the 2d, confirming that of the day before, had therefore gained four hours' time ahead of the storm, and everything was ready to meet the emergency. *Thanks to the precautions thus taken*, there was no damage, no disaster to deplore."

The Genoese *Journal*, of December 3, says that "the prediction telegraphed by the Paris Observatory to Turin, and immediately communicated to the ports on the western coasts of Italy, on the 1st instant, was fully realized. The first signs of the storm were felt yesterday, about 7:30 p. m. During the night it raged furiously; but there appears, nevertheless, to have been no disastrous occurrence in our neighborhood. The commandant of the port had hastened to take all proper measures, and we may be thankful for them."

Prof. J. P. Espy, in his second report on meteorology, makes, among many others, the following "generalizations" from the observations made and collected up to the year 1850, the date of that report:

"Storms in the United States, travel from the west toward the east.

"They are accompanied with a depression of the barometer near the central line of the storm.

"They are generally of great length from north to south, and move side foremost toward the east.

"Their velocity is such that they travel from the Mississippi to the Connecticut River in about twenty-four hours, and from thence to St. John, Newfoundland, in nearly the same time, or thirty-six miles an hour; and

"The force of the wind is in proportion to the suddenness and greatness of the depression of the barometer."

Subsequent observations have fully confirmed the truthfulness of these important deductions, which may therefore be set down as established facts or principles in meteorological science. The storm of March 22, 1861, is known to have occupied eight hours in passing from Dubuque, on the Mississippi, to Milwaukee, on Lake Michigan.

Now, it is quite clear that, if we could have the services of a competent meteorologist at some suitable point on the lakes, with the aid of a sufficient corps of observers with compared instruments, at stations located every two or three hundred miles toward the west, and the co-operation of the telegraph companies, the origin and progress of these great storms could be fully traced; their their velocity and direction of motion could be ascertained; their destructive force and other characteristics noted—all in time to give warning of their probable effects upon the lakes.

Doubtless there would be failures, and mistakes made; and many experiments and repeated observations would be necessary before the system could be made to work with perfection. But is not the object sought of sufficient importance to justify such a sacrifice? If it should prove successful in even one case, it might be the means of saving property worth many times the cost of the experiment.

But how shall all this be accomplished, and who will assume the burden of its cost? Perhaps the establishment of a meteorological department of the Chicago Academy of Science, with a proper organization and a *sufficient endowment*, would be the most likely to secure the desired results. The money should come from those most likely to be benefited."

"MILWAUKEE, WIS., December 8, 1869.

DEAR SIR: I take the liberty of calling your attention to the accompanying list of disasters to the commerce of our great lakes during the past year, and to ask whether its appalling magnitude does not make it the duty of the government to see whether anything can be done to prevent at least some portion of this sad loss in future. Yours, very truly,

I. A. LAPHAM."

Hon. H. E. PAINE, M. C.

OUR LAKE MARINE—RECORD OF DISASTERS FOR 1869—NUMBER OF DISASTERS REPORTED, 1,914—ESTIMATED DAMAGE TO PROPERTY, $4,100,000 —INTERESTING TABULAR STATEMENTS.

Navigation having practically closed for 1869, in accordance with our custom we lay before the readers of the *Sentinel* a record of the disasters which have been reported during the season. The list is very long, and the estimated damage to hulls and cargoes unusually heavy. According to our summary, the number of vessels which met with disaster is 1,914, against 1,164 last season—showing an increase of 750. In 1868, 103 vessels were totally wrecked, whose measurement aggregated 26,441 tons. This season the number totally lost is 126, with a measurement of 33,892 tons—which is certainly a large increase. Up to the 31st of October the amount of damage sustained by the shipping on the lakes was hardly equal to the average of seasons, and vessel owners and underwriters congratulated themselves upon their good fortune. But the storms of November, following in quick succession, and each even more violent than the preceding one, swept away all these bright prospects and burdened both owners and underwriters with heavy losses. The disasters reported in November number 403, involving damage to property of upward of $2,000,000. These are probably the highest figures ever reached in any one month since the navigation of the lakes began. The loss of life during the season was considerably less than in 1868. The tables which complete our summary are valuable for future reference and should be preserved.

* * * * * * * *

RECAPITULATION AND COMPARISON.

	1869	1868
December, 1868	4	. .
January, 1869	1	1
February	4	. .
March	. .	. .
April	14	91
May	9	27
June	15	47
July	15	14
August	15	15
September	14	53
October	21	56
November	96	16
December	1	1
	209	321

This memorial was accompanied by the following bill: (R. H. 602.) which was introduced in the House of Representatives December 16th, 1869, by the Hon. H. E. Paine, and referred to the Committee on Commerce and ordered to be printed.

A BILL

To authorize the Secretary of War to provide for taking meteorological observations at the military stations in the interior of the continent, and for giving notice on the northern lakes and Atlantic seaboard of the approach and force of storms.

Whereas the record of marine disasters on the northern lakes for the years eighteen hundred and sixty-eight and eighteen hundred and sixty-nine, shows that during the year eighteen hundred and sixty-eight one thousand one hundred and sixty-four casualties occurred, involving a loss of three hundred and twenty-one lives, and of property of the value of three million one hundred and fourteen thousand dollars, and that during the year eighteen hundred and sixty-nine, one thousand nine hundred and fourteen casualties occurred, involving a loss of two hundred and nine lives, and of the property of the value of four million one hundred and sixty thousand dollars; and that in eighteen hundred and sixty-eight one hundred and five vessels of the value of one million two hundred and seven thousand three hundred dollars were totally lost, and in eighteen hundred and sixty-nine, one hundred and twenty-six vessels of the value of one million four hundred and fourteen thousand two hundred dollars were totally lost; and whereas scientific observations have already shown that the course of storms in the United States is generally from west to east, and made known their rate of progress, and the changes of the barometer which precede and accompany them; and whereas a large proportion of the loss of life and property by marine disasters on the northern lakes might be avoided by timely notice to mariners of approaching storms; therefore,

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be authorized and required to take the necessary meteorological observations at the military stations in the interior of the continent and on the northern lakes, and to give notice on the lakes and Atlantic coast, by means of the electric telegraph, of the approach and force of storms.

Gen. Paine was strongly impressed with the importance of the subject, and requested an expression of views from the Surgeon General of the Army, Prof. Henry, Prof. Loomis, and from the Chief Signal Officer of the Army. The replies from these gentlemen were received and submitted to the House as follows:

WAR DEPARTMENT, SURGEON GENERAL'S OFFICE,
Washington, January 5, 1870.

SIR: I have the honor to state, in reply to your note of the 3d instant, that meteorological observations of barometer, thermometer, hygrometer, clearness of sky, and direction and force of winds, are now taken at all permanent military posts in the interior of the continent, as well as those on the seaboard and lakes. If means of rapid telegraphic communication with the most important points on the lakes and Atlantic seaboard could be secured, it would be entirely practicable for medical officers of the army, stationed in the interior, to give notice of the approach and force of storms passing from the direction of their respective stations.

I am, sir, very respectfully your obedient servant,

J. K. BARNES,
Surgeon General U. S. Army.

General H. E. PAINE, M. C.,
House of Representatives.

SMITHSONIAN INSTITUTION,
Washington, D. C., January 10, 1870.

DEAR SIR: Your letter asking my opinion of the practicability and merits of the proposition to establish, under the direction of the War Department, a system of telegraphic dispatches to forecast the approach of storms, was duly received, but on account of a press of business and the late recess of Congress I have deferred my answer until to-day.

There can be no doubt from the present state of meteorological science that a properly devised and intelligently conducted system of weather telegrams would be of great importance to the welfare of commerce as well as of much interest to the general public.

The first application of the telegraph to the forecasting of the weather was in 1856, by the Smithsonian Institution, and was continued sufficiently long to test the practicability of the enterprise, and indeed, use was constantly made of it during the winter to determine as to advertising lectures at the Institution.

Systems of the kind are now in operation in England, France, Holland, Italy, and other countries, and are producing results of sufficient importance to justify their maintenance at the expense of the government. The Atlantic seaboard of the North American continent is much more favorably situated for receiving intelligence of approaching storms than the western coast of Europe, since, as a general rule, the storms that visit the latter coast are generated on the ocean, from which no telegraphic signals can be sent; while a large majority of those which prove disastrous to the shipping of our eastern coast, have their origin on the land, and moving eastward may consequently be telegraphed in advance to the principal commercial cities of the east.

In order, however, that this system may be of practical value, it is necessary that, 1st. The points from which the telegrams are to be sent must be carefully selected and furnished with reliable instruments. 2d. These instruments must be in charge of persons properly trained to make the observations. 3d. The telegrams must be transmitted regularly to some central point at fixed hours of the day. 4th. They must at this center be collated and their indications interpreted by persons having a competent knowledge of the laws to which the motions of the storms are subjected. 5th. I do not think the military posts as now established will be sufficient to carry out the plan; additional stations would be required. 6th. An appropriation would be necessary for the pay of the telegrams, furnishing the instruments, and the necessary superintendence.

The Smithsonian Institution has for twenty years been engaged in collecting observations in regard to the climate and changes of the weather on the continent of North America, and has now a number of persons employed in reducing and discussing the materials which have been collected. It receives at the end of every month the records of simultaneous observations, made over the whole of the United States by about four hundred observers, and from these the laws of the phenomena, so far as it is possible to determine them, will in due time be made out. The cost of the application, however, of these laws to practical purposes, must be defrayed by the government or by the community which is most interested in the results. I may, however, be allowed to add that any assistance or suggestions which may be required in organizing the proposed system of weather telegrams will be cheerfully furnished by this institution.

I have the honor to be, your obedient servant,

JOSEPH HENRY.

Hon. H. E. PAINE,
House of Representatives.

YALE COLLEGE, January 10, 1870.

DEAR SIR: I have carefully read the memorial of Professor I. A. Lapham, recommending the establishment of a system of observations to give warning of the approach of violent storms, and heartily approve of the object of that memorial. It cannot be doubted that violent storms are subject to natural laws; that these laws have to some extent been discovered; and there is reason to believe that by patient investigation these laws may become still better known. One principle which has been derived by induction from a large number of cases is that over the United States violent storms do not long remain stationary in one locality, but travel from place to place; usually from west to east, or from southwest to northeast, and with a velocity varying from zero to forty miles per hour. What this direction is, and what is the velocity of its progress, can be ascertained in the case of any storm by a comparison of a sufficient number of recorded observations; and if every storm for a few years were tracked in this manner, the laws which they obey would become pretty well known. After these laws had been fully discovered, it would be possible, whenever a storm was raging, to give warning of its approach to places toward which the storm was advancing, several hours before its violence was actually experienced. If all violent storms come from the west or southwest, then by a system of combined observations it would be possible to give warning, at the port of New York, of the approach of every violent storm; and such warning would unquestionably be the means of preventing many disasters to the commerce of that port. It is believed that our knowledge of storms is already sufficiently precise to enable a competent meteorologist to furnish information which would be of great value to commerce, provided he had at his command a sufficient corps of observers scattered over a considerable area to the west and southwest, and also had the means of transmitting his warnings immediately by telegraph; and if such a system were pursued for several years, it could scarcely fail to conduct to more precise knowledge, which would render it possible to give more reliable and definite warning of the approach of dangerous storms.

In order to secure the objects here contemplated, it would be indispensable to have observations from a pretty large number of stations at intervals not exceeding one or two hundred miles, and scattered over a region to the west and southwest of those points for which the warnings were regarded as specially important. These observations should include all the meteorological instruments, but more particularly the barometer with the direction and force of the wind. The observations should be made daily at fixed hours, and should be reported by telegraph to some competent meteorologist, whose business it should be to compare the reports without delay, and make the proper deductions from them, and whenever a violent storm was in progress, to decide in what direction and with what velocity it was traveling; determine what places it would visit, and at what hour it would arrive; and finally transmit the announcement immediately by telegraph to those places specially interested. Such a system could not be expected to attain satisfactory results without a pretty large number of well selected stations, and especially without the services of a competent meteorologist to superintend the entire system. The superintendent should be well informed respecting the progress which has been already made in this department of science —he should have strong faith in the practicability of attaining useful results by a system of storm-warnings; and he should have no other engagements which would prevent him from giving his whole attention to this subject, especially whenever a violent storm was raging in any part of the United States.

A system of meteorological observations has been for many years in progress under the direction of the Smithsonian Institution, and this system now covers a large portion of the United States. By combining a selected number of these observers with the observations at our military posts, the whole country might be covered with a net-work of observations which would be tolerably complete. I have great confidence that a general system of observations might be organized which would not only be of great value to science, but which would, in a few years (if not in the first year), give such increased security to commerce as would more than compensate for the necessary observations.

I am, with much respect, yours truly,

ELIAS LOOMIS.

HON. HALBERT E. PAINE.

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL OFFICER,
Washington, D. C., January 18, 1870.

SIR: I have examined with interest the bill you send me (H. R. 602), with the papers accompanying it, and I have submitted your communication to the honorable Secretary of War.

The subject of storm telegraphy had attracted my attention at the time of the heavy gales of the last fall upon the northern lakes—one of these gales was fully reported some hours in advance, and might have been telegraphed and signaled —and, by a coincidence, I had caused some maps, showing possible coast telegraphic and signal stations, to be arranged for the War Department, before the congressional papers reached me.

I have been much impressed with the importance of the endeavor proposed in the bill prepared by you, as an aid and safeguard to navigation, and as a mode not before availed of in this country, of utilizing, in the interests of commerce, the posts and force which must be maintained for military purposes in the interior and upon the sea coast.

No reason suggests itself to me to doubt that meteorological observations, sufficiently minute to be useful, can be made at different posts and points determined upon.

The transmission of such intelligence as is gained can be so systemized as to insure its certainty. Military posts are now scattered from the Pacific coast, throughout the interior, to the Atlantic. The branching lines of telegraph, increasing in number, are daily binding them more closely together, and bringing them in communicating range of the great business centers. Other points of observation and report could be established gradually. In time, even the ocean cables may be made to serve a part. Meteorological observations, statistics, and reports giving the presence, the course, and the extent of storms—the telegraph can announce their location, as stated, and their probable approach, as it would, in time of war, those of an enemy.

It seemed fair to conclude that, with experience, the direction and range of many storms could be foretold with reasonable accuracy. It is certain they might be in some instances. As I write this letter, I quote, as a commonplace illustration, a storm report I find in the Washington *Chronicle*, of this morning (Jan. 18), made as an item of newspaper news only, and probably without any care, concert, or haste as to its reporting.

St. Louis, January 17.—A terrible storm of thunder and lightning, wind and hail, passed over the city *last evening.*

This was the evening of January 16.

Chicago, January 17.—During the thunder-storm *last night* the mercury stood at 42°.

This was the night of January 16.

Louisville, January 17.—A terrible tornado visited Cave City Station, on the Louisville and Nashville Railroad, at an early hour *this morning.*

This was the early morning of January 17.

Cincinnati, January 17.—An unusually heavy storm of wind and hail, accompanied with thunder and lightning, occurred here *this morning.*

This was the morning of January 17.

Pittsburg, January 17.—A heavy rain storm, and thunder and lightning, visited this place at *noon to-day.*

It is fair to presume that the storm of lightning, hail, and rain, the outskirts of which passed over Washington about six o'clock last evening (the evening of January 17), and was noticed by many as usual, was a part of this storm telegraphed at St. Louis on the evening of the 16th instant. If so, it could have been reported almost hourly in its course to this city.

A single storm report, wisely made upon the plan suggested by you, might save, perhaps, many times the cost of the experiment. Sufficient successes of organized systems of reports, having similar ends in view, in England, France, and on the shores of the Mediterranean, are already of record to warrant the endeavor on this side of the Atlantic, and, to suggest the thought, it would be almost wrong to fail to make it in a country so extended and having such shipping interests as our own.

Such information of storms as could be gained, once received at chosen points, could be collated, posted, and announced in merchants' exchanges and to boards of trade in the principal seaport and lake cities, and plans of signals similar in effect to the coast-storm signals put in use some years ago on the coasts of England and France, shown on the seaboard forts and at selected stations, by men already in the employ of the United States, could communicate the possible danger to vessels passing in sight at sea or preparing for departure from their ports.

The brief examination I have been able to give the subject seems to show that, with forty-four sea-coast stations already owned by the United States, intelligence of value could be notified in this way by day or at night for the use of vessels in the vicinity of each of our prominent ports.

I do not doubt that the general plan of collecting and announcing storm reports you initiate, well executed, with the extended knowledge and improvement to which it would lead, would save, in frequent instances, both life and property. The measure, once placed by enactment in some organized form, will grow in importance. Insurance companies, boards of trade, and commercial bodies, and shippers will be prompt to see the attempted benefit, and give it the aid of their co-operation. I hope the bill, or one having the same ends in view, will become a law, and I think the results to follow its passage, though they may not be at once attained, nor had without time, labor, and trouble, will be gratefully appreciated by the commercial world.

I am, sir, very respectfully, your obedient servant,

ALBERT J. MYER,
Brevet Brigadier General and Chief Signal Officer of the Army.

Hon. HALBERT E. PAINE,
House of Representatives, Washington, D. C.

The letter of the Chief Signal Officer led to a personal interview with Gen. Paine, and the substitution of the following joint resolution for the bill as originally drawn and presented:

JOINT RESOLUTION

To authorize the Secretary of War to provide for taking meteorological observations at the military stations and other points in the interior of the continent, and for giving notice on the northern lakes and seaboard of the approach and force of storms.

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he hereby is, authorized and required to provide for taking meteorological observations at the military stations in the interior of the continent, and at other points in the States and Territories of the United States, and for giving notice on the northern lakes and seaboard, by magnetic telegraph and marine signals, of the approach and force of storms.

This joint resolution was introduced February 2, 1870, by Gen. Paine, who asked and obtained its immediate consideration and passage.

It reached the Senate the same day, and was referred to the Committee on Military Affairs, which reported it back without amendment, through its chairman, Mr. Wilson, of Mass., on February 4th. It was passed by the Senate without opposition, and became a law through the President's approval, February 9, 1870.

On February 28, 1870, the Chief Signal Officer was informed by the Secretary of War that he was charged with the duties to arise under the provisions of the law, subject to the general supervision of the War Department.

In August, 1870, a small pamphlet was issued from the Signal Office, entitled.

GOVERNMENT TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE,

from which the following extracts are made, as illustrative of the preliminary work of the signal office in the establishment of the new service :

"Popular attention is at this time directed to the formal undertaking, for the first time on this continent, under Government auspices, of an organized system of weather reports to be made by telegraph, with the purpose of giving information in advance of the approach and force of storms for the benefit of commerce on the northern lakes and seaboard. The advantages to be gained, if success can be had, are so vast, and popular curiosity in reference to the subject is so general, that a brief statement of what has been undertaken in this regard in other countries, and of the steps which have led to the present action in our own, is thought worthy of publication.

"The special characteristic of modern efforts, in the development of meteorological science, consists in co-operation among observers laboring in different fields, and thus securing the data for determining the simultaneous condition of the atmosphere over extended regions of country.

"It is only by this means that the laws which govern the occurrence, motion, direction and propagation of atmospheric disturbances can be ascertained. As soon as this truth was recognized and acted upon, the important fact was developed that storms moved in certain fixed directions, and at such rates of speed as permitted telegraphic notice of their approach to be given to places lying in their paths.

"The practicability of utilizing this knowledge for the benefit of the commercial interest became at once apparent, and resulted in the organization of systems of storm warnings in several of the European countries most interested in maritime affairs.

"To the late Admiral Fitz-Roy, of the British Navy, belongs the honor of having been the first to put in operation a practical system of weather forecasts and storm signals, based on deductions made from numerous observations received by telegraph daily, at a central point.

"The first cautionary or storm-warning signals were made in England in February, 1861, and in August of the same year published forecasts of the weather were tried with such success, that by the spring of 1862 sufficient experience had been gained to justify the adoption of the system still in use.

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"The value of the forecasts given is shown in a statement made by General Sabine to the Board of Trade. He says that he had examined the warnings given during the two years ending 31st of March, 1865, and found that in the first year fifty per cent. and in the second year seventy three per cent. were right. Warnings of storms were sent by Admiral Fitz-Roy to the north and west coasts of France, and from comparison with the records for the two winters of 1864–65 and 1865–66 it appears that of one hundred warnings sent during the first of these winters seventy-one were realized, and during the second winter seventy-six; and out of one hundred storms which occurred, eighty-nine were signaled during the first winter and ninety-four during the second winter.

"In 1861 the Imperial Observatory of Paris commenced publishing, in the form of a daily bulletin, weather reports from different points in France, which proved so interesting to the scientific world, and useful to navigation, that the system was extended throughout Europe, reports from each principal city being received daily in Paris, where they are discussed and the results transmitted by mail to all parts of the world in the successive numbers of the International Bulletin. In 1863, the Observatory added to the bulletin a lithographic outline map of Europe, upon which diagrams are drawn, showing the barometric curve of the previous day through the various stations reporting, together with the temperature and direction and force of the wind, so that one can see at a glance the condition of the atmosphere as it was all over Europe the day before.

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"In carrying out this system of observations, France has been divided into districts, each consisting of a department, and in charge of a competent superintendent. By this arrangement much valuable material has been collected and many useful rules issued for the guidance of the agricultural community.

"In Russia, a system of meteorological observations bas been established, forming a net-work of stations throughout the empire, from which simultaneous daily reports are made to St. Petersburg, where they are collected and published for the benefit of commerce, and distributed throughout Europe.

"In Italy a similar system has been in operation for some years, and valuable reports are also made from Holland, Austria, and Norway, but not issued daily in the bulletin form.

"In Austria alone, one hundred and eighteen stations are reported where observations are taken by scientific men, who labor without remuneration and the results of whose labors are annually published by the Government.

"In Germany and Denmark, where the telegraphs are under Government control, telegraphic announcement of the approach of storms is sent to all seaports by the operators who are especially charged with the performance of this duty.

"The importance of regular meteorological reports was early recognized in this country, for the Medical Department, United States army, commenced taking observations in 1819. The States of New York, Pennsylvania, and Ohio followed in 1825, 1837, and 1842, respectively, and the Smithsonian reports in 1849. The observations, while valuable to the scientific world as studies for future application, or in reference to the sanitary condition of localities, were at first of no immediate benefit, and it was only when the introduction of the telegraph made their rapid transmission possible that attention was drawn to the possibility of practical storm warnings. In 1857 the Smithsonian Institution in Washington was in the daily receipt of weather telegrams, transmitted gratuitously by the telegraph companies, from various places east of the Mississippi and as far north as New York, and published in the Washington *Evening Star*. In 1858 a map was hung up in the Institution, on which was shown daily the changes of weather reported by telegraph from different parts of the country. Reference was frequently made by Professor Henry and the able correspondents of the Institute to the practicability of more extended plans of this description.

"In the same year the American Association for the Advancement of Science appointed a committee for the organization of a national system of meteorological observations, and a plan was presented, which provided for the appointment of a superintendent in each State, who was to collect and collate all observations within its boundaries, and forward them monthly to Washington. The expense of maintaining such a system was to be borne by the different States. No action was taken in the matter, however, and the daily publication of reports of the Smithsonian continued until the breaking out of the war in 1861, when it was suspended, but renewed again temporarily in 1862; but finally discontinued, owing to the cessation of observations in the southwest, and the constant use by the Government of the telegraph lines. In 1863 the newly appointed Commissioner of Agriculture commenced the monthly publication of a bulletin, giving the state of the weather and condition of the crops throughout the country from data furnished by correspondents. This publication is still continued, and is of value to the agricultural interests of the country. In 1869 a daily bulletin of the weather was published for three months in Cincinnati, Ohio, under the direction of Professor Cleveland Abbe, and the experiment proved so successful that it was renewed during the present year. Since 1863 several persons have endeavored to get congressional assistance in organizing the national system suggested by the Association in 1858. Mr. A. Watson, of Washington, has been earnest in advocating in the papers a system of storm signals for the benefit of agriculture.

"Professor I. A. Lapham, LL. D., of Milwaukee, has been a persistent and successful advocate of the importance of some national system of weather reports, in which the telegraph was to play an important part, and he brought powerful arguments to bear in the shape of statistics, showing the loss of shipping on our lakes alone for a series of years. His views were brought strongly to the notice of Congress in 1869, in a memorial replete with interest. By a coincidence, papers and maps in reference to the same subject were prepared in the War Department at the time the memorial was submitted.

The matter was finally brought to the attention of Congress by the Hon. H. E. Paine, of Wisconsin, who offered the joint resolution which became a law on the 9th of February, 1870.

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The fact that in the north temperate zone storms almost invariably come from some westerly point, and follow an easterly course, renders the application of storm warnings in the United States of more immediate utility than in Europe, where the principal points, being on the eastern coast, are first affected by the storms. Here, as soon as a storm appears in the territory bordering the Rocky Mountains, it becomes possible, in many cases, with proper arrangements, to telegraph its approach to eastern cities in time to enable preparations being made against its destructive influence. It is not absolutely necessary that the observers or reporters should be scientific men, though the higher their grade of education the better, but that they should promptly announce the existence of a storm, with other meteorological facts, to the places lying within its probable path. It is essential they should be held to a proper responsibility, and be under strict official control. The form of report must be carefully devised and regulated. A series of reports of this kind will make possible in time the mapping out of each individual storm, and from this material can be deduced some general laws governing their movement. For example, the great storm of March 13–17, 1859, was thus mapped out by Professor Lapham, and its course found to run from western Texas, where it first struck our coast, in a northeast direction, to Lake Michigan, which it reached in twenty-four hours, thence to the Atlantic coast in another twenty-four hours, and finally leaving the continent at St. Johns, Newfoundland, in ninety-six hours after its first announcement. Here was a regular movement about as rapid as a railroad train, and as easily kept under supervision.

In a memorial to the Forty-First Congress, Professor Lapham says: "If we could have even a few hours' notice of the approach of the great storms that bring these calamities upon us, much of their mischief might be avoided."

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"It is quite clear," writes an eminent meteorologist, referring to these and other premonitions seemingly established by meteorological statistics, "that if we could have the services of a competent meteorologist at some suitable point on the lakes, with the aid of a sufficient corps of observers, with compared instruments, at stations located every two or three hundred miles toward the west, and the co-operation of the telegraph companies, the origin and progress of these great storms could be fully traced; their velocity and direction of motion ascertained; their destructive force and other characteristics noted, all in time to give warning of their probable effect upon the lakes."

It must be remembered, however, that "there may be failures and mistakes made; and many experiments and repeated observations may be necessary before the system can be brought to work with perfection; but is not the object sought of sufficient importance to justify such a sacrifice? If it should prove successful in even one case, it might be the means of saving property worth many times the cost of the experiment."

It should not be allowed to escape attention, that while such generalizations as those above are held by many of the wisest and most careful meteorologists, there are those of much research who have different views. The absolute truth, it seems, will be arrived at only when careful, systematic, and official observations shall have done away with many causes of error and difficulties in the way of truthful deductions which such observations solely can remove.

The system inaugurated by Congress is designed for the protection of the seaboard as well as the lake districts. It is hoped to extend its benefits to all the coasts and, by the necessary stations, to the great navigable rivers of the United States.

The plan so far determined upon by the War Department contemplates the simultaneous observation of atmospheric phenomena, the telegraphic transmission of reports of these observations, and the wide-spread publication of the reports at all points where they will be of service to the commercial interests of the country. What is proposed in the present and contemplated in the future is clearly stated in the following "memorandum," issued from the department in Washington charged with the performance of the duty:

1. *Observation and Report of Atmospheric Phenomena.*

a. A series of meteorological observations and reports will be made by careful observers under military control, and supplied with the best attainable instruments. All instruments will be adjusted to a standard at Washington.

b. The observers will be stationed at points throughout the United States, selected by competent authority, as those from which reports of observations will be most useful, as indicating the general condition of the atmosphere, or the approach and force of storms.

It has been in view to so locate these stations that, the existence of a storm at one or more of them being determined, information of the facts may be had by the regular reports communicated by telegraph in advance of its probable movement.

c. Synchronous observations will be taken, and reports made from the stations three times a day, one about 8 a. m., one about 6 p. m., and one at midnight. These observations and reports will be timed by Washington time. The office is in a measure led to this selection of hours by the press of business at other times upon the telegraphic lines. Other observations will be made for record.

2. *Transmission of Reports.*

a. The reports of observations are to be transmitted by telegraph, under a special arrangement with the telegraph companies whose lines connect the different points where stations will be established.

b. By a combination of telegraphic circuits, the reports of observations made at different points synchronously will be rapidly transmitted to the different cities at which they are to be published. They will also be concentrated at Washington. The whole time required to transmit, collate, and deliver the reports, from the extreme points of observation to the points of publication, will, it is hoped, not exceed one hour.

3. *Publication of Reports.*

a. It is intended to give the widest publicity to these reports, in order to make them useful to the greatest number. Copies of all reports will be furnished to the different papers for publication, and each report will be bulletined in the board of trade rooms, merchants' exchanges, or other conspicuous places, immediately upon its receipt.

b. So soon as the necessary arrangemements can be had, a meteorological map on which the changes can be noted as each report is received, will be displayed a the board of trade rooms, or other business centers in each city receiving reports. Similar maps will be furnished the different scientific establishments cooperating with the department.

c. The reports will be limited at the outside to the simple statement of meteorological facts existing at the stations of observations. These facts, together with such general laws as seem to have been determined by meteorological observations hitherto made and as may permit probable deductions to be made from the reports, will be published.

d. It is not deemed advisable to attempt at the outset, further than in this way, predictions which must often be erroneous.

e. Whenever experience has certainly determined what may be regarded for any section of country as premonitions of approaching storms, signal-stations will be established as quickly as the necessary arrangements can be made, and signals will be displayed announcing their probable approach, with other information which may be possible.

f. The observer, when one is stationed in any city, will be constantly on duty during business hours, and every facility will be given to obtain copies of the bulletins, or other full and the latest information.

4. *Stations.*

The following have been designated as stations of observation and report, or of report alone, and will be occupied as rapidly as arrangements can be effected :

Plaister Cove, N. S.; St. Johns, N. B.; Portland, Me.; Boston, Mass.; New Haven, Conn.; New York City, N. Y.; Philadelphia, Pa.; Baltimore, Md., Washington, D.C.; Wilmington, N. C., Charleston, S. C.; Augusta, Ga.; Savannah, Ga.; Lake City, Fla.; Key West, Fla.; Montgomery, Ala.; Mobile, Ala.; New Orleans, La.; Jackson. Miss.; Memphis, Tenn.; Nashville, Tenn.; Louisville, Ky.; Cincinnati, Ohio.; Knoxville, Tenn.; Albany, N. Y.; Syracuse, N. Y.; Oswego, N. Y.; Rochester, N. Y.; Buffalo, N. Y., Cleveland, Ohio; Toledo, Ohio; Detroit, Mich.; Chicago, Ill.; Indianapolis, Ind.; St. Louis, Mo.; Milwaukee, Wis.; St. Paul, Minn.; Duluth, Minn.; Omaha, Neb.; Cheyenne, Dak.; Corinne, Utah.; Santa Fe, N. M.; Fort Benton, N. M., San Francisco, Cal.; Pittsburg, Pa.

The staff of the signal office during the year 1870 and 1871, covering the period of organization, was composed of the following named officers:

First Lt. L. B. Norton, Property and Disbursing officer, detailed April 7, 1865, died, December 23d. 1871. Succeeded by 1st. Lt. Henry Jackson, who remained until August 12, 1876.

Second Lt. H. W. Howgate, in charge of stations, detailed April 18, 1868, and who is still on duty.

Capt. C. M. Pyne, Adjutant, detailed April 16, 1870, relieved December 15 1870 and succeeded by Capt. Garrick Mallery, who remained until August 17, 1876.

In November 1870, Prof. Lapham, of Milwaukee, was employed as civilian assistant to the Chief Signal Officer and stationed at Chicago, with special reference to the supervision of the Signal Service on the lakes.

The services of Prof. Cleveland Abbe, were secured January 3, 1871, since which date he has remained on duty in the Signal Office.

Prof. Thompson B. Maury, entered upon service as assistant to the Chief Signal Office June 18, 1871, and remained until his resignation on November 30 1875.

First Lt. Robert Craig, was detailed February 1, 1871, and 2d. Lt. A. W. Greeley, July 6, 1871, and both officers were employed during the year upon the studies and preparation of the charts and papers necessary to fit them for duties in connection with this service.

On November 1, 1870, at 7.35 a. m., the first systematized synchronous meteoric reports ever taken in the United States were read from the instruments by the observer-sergeants of the signal service at twenty-four stations, and placed upon the telegraphic wires for transmission.

With the delivery of these reports at Washington, and at other cities and ports to which it had been arranged they should be sent, which delivery was made by 9 a. m., commenced the practical working of this division of the signal service in this country.

On the first day of report the tabular bulletin reports were bulletined and furnished at twenty- four cities. The organization and instructions seem to have been sufficiently minute to guard against accident or error.

The issue of synopses and probabilities, as they are styled, was commenced by the office on February 19, 1871, and has been made thrice daily since that date.

The synopses consist of a synoptic view of the meteoric condition of the United States, collected from the data received at each regular report.

The probabilities are the deductions made by the office, from the data in its possession at the time of each report, as to the meteoric conditions probably to occur during the ensuing eight hours.

The following extracts are from a report made from Professor I. A Lapham to the Chief Signal Office, January 16, 1871:

"All papers, reports and instruments were placed subject to my inspection, and all facilities were directed to be afforded me in the discharge of these duties. My instructions were to furnish daily to the Chief Signal Officer for his consideration, as quickly as possible after receiving the morning reports, a brief sketch of the reports received for the twenty-four hours preceding (or for a longer period), as to facts bearing upon the probable weather, with a statement of the probable character of the weather for the next twenty-four hours; and in case of imminent danger the dispatches were to be immediately published along the lakes by the several observers, without awaiting orders from the Chief Signal Officer.

In the prosecution of this work I have had occasion to suggest certain changes and improvements in the methods of doing this important work in hand, some of which have been adopted and have resulted in saving the time of the observers and of securing greater accuracy of results.

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"In compliance with these instructions I proceeded each morning, with as little delay as possible, to construct a skeleton chart of the matter on a large sheet of paper, upon which the relative positions of the several stations had been marked, showing the height of the barometer above or below the mean (announced to be thirty inches), the state of the matter, the temperature, the direction and velocity of the wind, etc., at the several stations from which reports were received. These items were so connected by lines (in different colors) as to show the districts where the barometer and the temperature were high or low, when rain or snow was falling, etc., thus representing to the eye in a comprehensive manner the condition of the weather over the whole country, from the Atlantic to the Rocky Mountains, and from the Gulf of Mexico to the great Northern Lakes.

With the aid of the meteorological chart and the column showing the amount of change since the last preceding report, and with a general knowledge of the character and movement of storms over the interior of our continent, we can readily determine what predictions to send forward.

Comparing one of these with the next preceding, the progress of weather changes as they move over the country can at once be seen, and their direction and velocity ascertained.

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The first dispatch of the signal service sent from Chicago was dated at noon on the 8th of November, 1870.

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A glance at the skeleton-charts daily prepared to show the meteorological phenomena more readily to the eye, shows the magnificent extent of the atmospheric distances that then follow each other with such rapidity over the country. The several lines of equal barometic pressure seldom inclose a space within the region covered by the stations. * * *

These lines are mostly in the form of curves of very great radius. * * Such far-spreading phenomena can surely not be produced by any local changes of temperature." * * *

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These extracts are interesting as showing the first steps taken by the Signal Service in the discussion of weather reports, the preparation of charts and the issue of forecasts.

They also furnish valuable data in reference to the question of priority among the numerous applicants for the honor of originating the present system of weather work of the Signal Service.

On January 1, 1874, in pursuance of an arrangement between Professor Henry and the Chief Signal Officer, the very extensive system of meteorological reports made by volunteer observers throughout the United States, under the supervision of the Smithsonian Institute, was transferred to the charge of the Signal Office.

On June 19, 1874, the series of meteorological observations made at military posts and stations throughout the United States, were transferred to the Signal Office by the Surgeon General of the Army, thus concentrating the official meteorological work of the country in one office and under one management, where it has since remained.

CLOUDS.

PROF. S. A. MAXWELL, MORRISON, ILL.

Clouds are masses of aqueous vapor condensed to such an extent by a diminution of temperature as to become visible. A given quantity of air will remain transparent so long as it is capable of absorbing watery vapor, and when it can absorb no more, it is said to be *saturated.* Even in this condition it is quite transparent; but if from any cause the temperature is lowered, a portion of the moisture is condensed, forming minute, though visible, vesicles of vapor, such as are seen floating in the air during a fog. These vesicles are hollow spherules sufficiently opaque to render the clouds which they form able to exclude the sun's rays either wholly or in part. The temperature of a saturated portion of air may be diminished in two ways—a cold current of air may enter it, or it may itself rise into a higher and colder stratum. The result of either of these conditions is usually the formation of clouds; and all or nearly all precipitation is due to the cooling of ascending currents at a vast height.

There are seven distinct varieties of clouds, arranged in two groups, known as primary and secondary. The primary group embraces the varieties called cumulus, stratus, cirrus, and nimbus; the secondary, the forms designated cirro-cumulus, cirro-stratus and cumulo-stratus. This classification is quite faulty, as the words primary and secondary are not used in their true meaning. The word *primary* signifies pertaining to the first, hence *primary clouds* ought to mean the original or first forms of clouds—those forms which they assume at the beginning of their existence. Now, of the four varieties styled "*primary clouds*," but two, the stratus and the cumulus, can properly be called primary, as they only are original forms. A better classification is as follows:

CLOUDS.	I. Primary or Original.	*a.* Stratus.
		b. Cumulus.
	II. Secondary or Transformed.	*c.* Cumulo-stratus.
		d. Nimbus.
		e. Cirro-stratus.
		f. Cirro-cumulus.
		g. Cirrus.

The processes of cloud formation and transformation are easily understood if we are sufficiently observing. The manner in which primary clouds originate has been briefly stated already, or rather that part of the subject relative to the formation of the cumuli—an interesting phenomenon which may be witnessed during the forenoon of almost any day in summer. The name, stratus, is applied to that form of cloud which often floats near the surface of the earth after a heavy rain-storm, also to those with which, in autumn and winter the entire heavens are often obscured. A third though less common form of the stratus is sometimes seen during the evening of the cooler days of summer, and is caused by the settling of cumuli to lower strata of air. The lower portion of a cloud when approaching the earth in this manner, is usually changed to invisible vapor, the air which it enters being warmer and consequently more capable of holding moisture. The rounded or conical form of the cumulus is by this means made to resemble the stratus, and after a short time, a perfect form of the latter will be produced by lateral expansion caused by gravity. This form of the stratus is short-lived, never being converted into any other kind of cloud—but is soon dissipated into invisible vapor. That form of the stratus which is often seen just after a heavy rain (particularly if the latter be followed by a strong east or south-east wind), is produced when the lower stratum of air is, in its parts nearest the earth's surface, too warm to be in a saturated condition, while at an elevation of a few hundred yards the temperature is so low as to cause the vapor to condense. When this phenomenon occurs there are usually two strata of clouds, one moving diametrically opposite or at right angles to the other. This form of the stratus is an original cloud while that previously described is a modification of the cumulus. The direction taken by these clouds, is one of the best of weather indicators.

If, after a storm, they move *toward* the north-west, another storm is almost sure to follow. This circumstance generally indicates a large area of "low barometer," the center of which is still to the westward of the place of observation. If on the contrary, these stratus clouds move *from* the west or north-west, it indicates rising barometer, fair weather and lowering of temperature. It takes comparatively little experience in weather observation, for one to foretell the weather with tolerable accuracy whenever these clouds appear. The stratus is never transformed into the nimbus as some meteorologists have supposed. It is true that mist sometimes falls from these clouds, but even then there is so wide a difference between them and true rain-clouds—both in form and origin—that it appears unscientific to consider them rain-clouds. One reason why some have supposed that these forms yield rain or are transformed into rain-clouds, is doubtless due to the fact that the heavens being sometimes over-spread with them, rain begins to fall and continues to do so for a considerable time and in large quantities. The truth is simply this—the stratus floats low and obscures the storm-cloud which is at a much greater altitude. The rain falls *through* the stratus; not *from* it—the rain-drops beginning their descent from points varying in elevation from two to ten times that of the base of the lower (stratus) cloud. This feature was particularly noticeable on the occasion of the great storm which passed over large portions of Iowa and Illinois on July 1st 1878.

The stratus more than any other form of cloud, has the power of absorbing light, or in other words it is a poor reflector. For this reason it always has a dark color, though its base is usually less dark than that of the cumulus. It is more uniform in color than the cumulus, while its edges are less sharply defined both of which facts are due to the difference in their densities.

Let us now consider the cumulus. This is truly the cloud of day, its typical form never appearing in our latitude in the night, unless the weather is very warm for the season. The word *cumulus*, signifies a *heap*, and is therefore definitive; giving a very good idea of the form of the cloud. These clouds are formed chiefly during the forenoon of warm days of spring and summer by the condensation of the vapor contained in ascending currents of air. They attain their greatest height during the hottest portions of the day; at which time according to Flammarion, they are 10,000 feet above the surface of the earth. In fair weather their thickness is rarely more than 2,000 feet, though no figures can be given as even approximately correct at *all* times; for latitude and temperature greatly modify both their dimensions and their altitude.

The cumulus, proper, is always an *original cloud*, by which is meant one formed directly from invisible vapor. Its base has a dark or black color, but the portions illuminated by the sun are of a beautiful white, sometimes changing to a yellowish or ruddy tint—to the former when there is much moisture in the intervening air, and to the latter when the air is filled with smoke or the so-called dry-fog, characteristic of Indian summer. No cloud possesses more beauty than this

—its clearly cut outlines and exquisite tints contrasting so admirably with the deep blue of the sky.

For this reason artists attempt its representation in their paintings, but commonly in a very imperfect manner, nature in this instance, defying Art with persistence and success.

The cumulus generally floats in the surface stratum of air. This can be verified by simple observation, the vane generally points *toward* the direction from which these clouds move. It is the cumulus which so often furnishes the temporary but refreshing shade to the weary out-door laborer, the severity of whose task is thereby greatly mitigated. It is the function of the cumuli to act as watetr-carriers, and in this capacity is their chief merit found. Millions of tons of water are daily conveyed in this manner with the speed of an express train from one portion of the country to another. Sometimes this water falls as rain and sometimes the clouds which it forms are dispersed and become again invisible vapor.

The two forms of clouds known as cumulo-stratus and nimbus, are but the cumuli in its more advanced stages of existence. When there is *low* barometer with high temperature, the cumuli instead of dispersing, congregate in vast masses, sometimes disposed in ranges resembling mountains with domes and peaks rising grandly against the background of the sky. These clouds rise to an immense height, their summits frequently being 25,000 feet from the surface of the earth. Their bases vary in elevation from 3,000 to 5,000 feet, consequently, their vertical thickness is very great. The apex of a thunder-cloud in hot weather, can be seen frequently on our western prairies, at a distance of two hundred miles.—This fact can be proved almost any summer's day by means of the telegraph.

In treating of *causes* we necessarily touch upon their *effects*, hence in speaking of clouds we must speak also of the phenomenon of precipitation. Meteorologists hold different views concerning the direct causes which produce rain. Rozet and Kaemtz hold that, it is due to the commingling of cirrus and cumulus clouds; the former being composed of frozen and the latter of vesicular vapor.

Now, I do not regard the cirrus as a *cause* of rain so much as an *effect*. The cirrus if I may so term it, is the ashes of the storm-cloud, being only an incidental product of the storm. If one of those scientists of Germany or France, who upholds the theory of Rozet, would spend one summer on our western prairies, he might see more than a dozen storms originate without a vestige of one of the cirri present in the visible heavens. It is a fact, however, that very soon after a cloud begins to yield rain, it assumes the so-called "carded appearance" on its almost vertical sides and as the top becomes smooth a small horizontal fan of cirrus or cirro-stratus proceeds from near the summit gradually expanding laterally and in front until it covers manyfold more territory than the true rain cloud from which it was developed. If our scientific friend should continue his observations of this shower, he might possibly have the privilege of witnessing how "storms die," for after the moisture of the cloud has mostly fallen as rain, he will notice the lower parts dwindling away, until by and by there will be no more "streaks of rain" under the cloud, and all semblance to the original cumulus or later nimbus will have disappeared—all that remains being a flat cloud, a true cirrus or cirro-stratus, which may dissolve in a short time and leave no trace of the storm or shower to which it once belonged. I have seen many instances of all these transformations, from cumulus to nimbus, from nimbus to cirro-stratus, from cirro-stratus to cirrus, and often the time required for these changes did not exceed an hour. It is much more common for the cirro-stratus to exist for several, hours then change to the cirrus in which form it will float for days, moving in an easterly direction, at an immense height. The little white films of cirri, which pass over us nearly every day, especially in hot, dry weather, are the ashes of storm-clouds whose force was spent on the peaks of the Rocky mountains, or possibly on the briny waves of the distant Pacific.

The ascending currents which form the cumuli and carry them to great heights, sometimes impart to them sufficient inertia to cause their entrance into currents of air having a temperature considerably below 32° Fah. When this takes place vesicles of vapor in the upper portions of the cloud become suddenly converted into buoyant frost-crystals, many of which speed away on the wings of the wind—the cold current moving much more rapidly than that containing the lower portions of the cloud. A large number of these frost-crystals and spherules of ice, descend into the lower and denser portions of the cloud, diminishing its temperature, thereby tending to produce precipitation; and no doubt in many instances rain does result from these conditions; though a far greater amount is caused by the cooling of ascending currents of humid air.

With regard to their *direction* of *motion*, clouds must, of course, take the direction of the current of air in which they float. In the different parts of the earth the direction of the prevailing wind varies. The direction of the cumulus and the stratus will usually be the same as the surface wind, while the direction taken by the other forms, is more or less independent of it. Of these the cumulo-stratus and nimbus, being formed from the cumulus, usually (at least during the day-time) take the direction of the surface wind; but the cirro-stratus and cirrus almost invariably move in an an easterly direction.

The cumulus, proper, as stated heretofore, is an original form of cloud, but there is occasionally a cloud which greatly resembles it, though it is a transformation. The cirro-stratus is a frozen cloud but sometimes becomes reduced to vesicular vapor, and soon after it collects into little, rounded, fleecy masses called cirro-cumuli. When this process continues for a considerable time all the distinguishing characteristics of the cirro-stratus will become obliterated, and the cloud assumes the exact appearance of the cumulus. It never attains very great size and owing to its immense height, appears almost motionless. It forms only in hot weather; and is quite often the harbinger of a storm.

The velocity with which clouds move depends mainly upon the velocity of the air-current in which they are suspended. The force of gravitation has a tendency to bring scattered clouds together; and when they have a common altitude, this is frequently the result. A large cloud obtains great additions to its volume in this manner—the small ones in its vicinity being gradually incorporated with it. I have observed this phenomenon more especially in the cumulus, and its derivative, the cumulo-stratus. It is obvious that this mutual attraction would in some cases accelerate and in others retard the motion of clouds; yet, in no case would the effect be visibly perceptible. The velocity of clouds may often be very closely determined by noting the rate of speed with which their shadows move. The lower clouds which appear to move so very rapidly, frequently have a slower rate of speed than those apparently motionless ones far above them. This, of course, is due to the fact that the latter are from ten to twenty times more distant.

Though the clouds are classified and the different forms named, it is nevertheless true, that at certain seasons of the year, the typical forms are rarely seen in our latitude. It is a fact worth noticing that the rain-storms of winter, in the northern parts of the United States are *not local showers*, but nearly all are great storms several hundred miles in extent, originating in a warmer latitude where the cumuli are the common day clouds in winter as in summer. The cumuli are germs of rain-clouds, hence, where the former do not exist, the latter will not originate,

It is not varying temperature alone that causes clouds to assume other than typical forms. As has been observed, there are frequent transformations, as the cumulus to the stratus, or the cirro-stratus to cirrus, therefore there is an infinite varietyof transitional forms, which are classed among those with which they bear theclosest resemblance.

The study of clouds is of much importance. If in this brief article enough has been said to stimulate some thoughtful mind to examine into it still further and bring to light some more of the truths of science, the chief object of the writer will be accomplished.

To persons of æsthetic natures the study of the clouds is particularly delightful. Poets in all ages have adorned their verse with similes in which "the clouds" have constituted one element of the comparison. The same idea of cloud-beauty has often been used by the orator on the rostrum, and the divine in the sacred desk, when they wished to adorn their speech with a jewel of metaphor.

A better knowledge of the science of meteorology is developing among the people of our country; and this is due in part to the efficient management of our Signal Service Bureau, and in part to the publication of numerous well-written articles on the subject by observers in different sections of our country. It is to be regretted that so many statements (in reference to atmospheric phenomena) found in popular text books, should be so far from the truth as they are. That such errors should exist, is to be expected, since daylight has but just dawned in the science of meteorology. But it is encouraging to know that the misty theories founded on ignorance and conjecture are rapidly giving place to those established by a careful study of the effects produced by the operation of natural laws.

MORRISON, Ill., Oct. 16, 1880.

GEOGRAPHY.

THE SURVEY OF WESTERN PALESTINE.

The Palestine exploration fund has just issued the first installment of the published results of its work on the Holy Land, consisting of a map, in twenty-six sheets, of Palestine west of the Jordan, to be shortly followed by volumes of memoirs containing all the information that has up to the present time been ascertained respecting the geography, history and archæology of the country.

The importance of this map to the study of the bible can scarcely be exaggerated. All previous maps have been constructed from the imperfect observations of the individual travelers, and distances and names were given for the most part conjecturally and at random. Now we have a survey of the country executed by English Engineer officers, and setting forth the topography and nomenclature with as impartial accuracy as an Ordnance map of an English county. It is now for the first time possible to read the narrative of Joshua's marches, of Judas Maccabæus, etc., and to follow the Biblical histories generally, in an intelligent way, mountains, valleys, roads, villages and towns being for the first time accurately laid down.

About 10,000 names incorporated in this map were found by Lieutenants Conder and Kitchener, the officers to whom the survey was intrusted, and the memoirs include a number of others discovered by the French and German explorers Guérin, Renan, Sepp, and others. Among all these exist in some form or other all the Biblical names, only 622 in all, of Western Palestine. These older Hebrew, Canaanitish, and Phœnician names, although they never disappear and leave no trace behind, are often very difficult of recovery, and their satisfactory identification is impossible without the aid of a work like the present, where exact topography and authentic information as to the present nomenclature are available to supplement and verify the deductions of archæological and philological research. In some cases, and these are comparatively few, the old name has survived almost unaltered, such words as Beit-Lahm and Bethlehem, Akka (Acre) and Akko, Bir Seba and Beersheba being such obvious survivals that, taken in conjunction with the collateral evidence from topography, no doubt whatever can be left as to their identity. Sometimes the older name has locally survived a later, though still remote, attempt to change it, as in the case of the ancient Bethogabra, which, though known for centuries as Eleutheropolis, is still called by the inhabitants Beit-Jibrîn, a form that is, if anything, older than Bethogabra itself. In other cases the identification is equally certain, though not by any means apparent to the uninitiated; for instance, Laish has in the Bible the superimposed name of Dan, meaning "Judge," and the spot where we should naturally look for the remains of the town, is called at the present day, Tell el Kadi, "the Judge's mound." So Paneas became Cæsarea Philippi, but is yet known as Baneas. Sometimes an old name having an approximate signification in the ancient Semitic tongues is misunderstood by the modern Arabic-speaking population, the Hebrew *nahl*, "a stream or water-course," being always confounded either with *nakhl*, "a palm-tree," or *nahla*, "a bee." It will be readily understood that a study of the name lists will yield most interesting results to Biblical students. In spite of the previous identifications, some 200 out of 400 known places have been proposed by the Survey officers. The rest will, no doubt, be recovered without much difficulty when the forms and meanings of the names here given have been thoroughly examined.

The geography of Palestine can now be re-written, for the map of the Survey enables us to lay down the tribal boundaries, etc., accurately; and as the physical features of the country are here exactly set forth, what was before mere conjecture and hypothesis can now be stated as ascertained fact. It is not the religious interest alone that makes the comparatively small territory of Palestine so worthy of deep and careful study. In ancient times the traffic between East and West went of necessity through the country, which became the highway of the world, the focus of trade, and the ground on which rival nations contended for pre-eminence. Here Egyptian, Assyrian, Persian, Greek, Roman, and Moslem civilizations and religions by turn held sway, and traces of their influence and ruins of their magnificence are found at every step. Here is the origin not only of Christianity and Judaism, but of most of those ancient myths around which Grecian art, learning, and philosophy clustered. On the sea-coast by Joppa arose the cult and myth of the fish-god Dagon, which appears elsewhere in the legends of Perseus and Andromeda, of Set and Typhon, of St. George and the Dragon, and even of the Archangel Michael and the Devil. From the Tyrian shore, a little further to the north, set out Cadmus, who colonized Greece, and whose very name is perpetuated to day in that of the river Casimiyel and the little Moslem shrine of Neby Casim, the Prophet Cadmiel or Casmiel. Close by is the shrine of Neby Mashuk, the Prophet "Beloved," which is nothing more nor less than the Egyptian temple set up to the terrible Melkarth or Moloch, under the euphemistic title of Miamûn, or the beloved of Amon. On to the shore above Beirut flows the Nahr Ibrahîm, the river of another "Friend of God," here identical with the well-beloved Tàmmûz or Adonis. And not only the ruins and the names, but the people themselves are curious and interesting objects of study, and Canaanites, Hittites, Amorites, Hebrews, Tyrians are still to be easily identified among the Fellahîn and Bedawîn of the country; in fact, to the theologist, archæologist, ethnologist, and historian every foot of Palestine has matter for research and contemplation, and all this has for the first time been made available as a whole by the labors of the Palestine Exploration Fund. Of these most interesting departments of the subject we shall speak more fully when the promised volumes of the memoirs appear; to the present publication, the map of the Survey, we can give unqualified praise. It is the joint work of Lieutenants Conder and Kitchener, and was completed in circumstances of exceptional difficulty, the disturbed state of the country in 1877 making it necessary to work day and night (Sundays included), often in the face of considerable personal danger.

The survey was commenced in January, 1872, and finished in 1877; it has cost during that period about £20,000, of which a large sum was expended from time to time in printing reports, etc. The necessary money was raised principally through the energetic action of the Secretary, Mr. Walter Besant, but it must have been relinquished had not Mr. Morrison, the treasurer, himself advanced funds from time to time to carry on the operations at certain critical periods of the Fund's finances.

The earliest Palestine Exploration Society in this country was founded in 1804, but attracted little support. In 1808 the committee published a volume entitled, "A Brief Account of the Countries Adjoining the Lake of Tiberias, the Jordan, and the Dead Sea" (Hatchard, Piccadilly), which was, however, only a translation of some rough notes made by the well-known traveler, Seetzen. Two travelers were then sent out by the society for the purpose of exploring the country, but owing to the accounts they received of the dangerous state of the country they did not proceed further than Malta.

The society after this lapsed into inactivity and its very existence was forgotten until 1834, when all the books, papers, and funds were handed over to the Geographical Society. In 1840 a fresh association was founded with no better results than the former; but in 1864 a survey of Jerusalem was made under the direction of the Ordnance Survey Department by Captain (now Lieutenant-Colonel) Wilson, Baroness Burdett-Coutts supplying the required funds. This called general attention to the defective state of information respecting the country, and in May, the next year, the present society was formally constituted, principally through the efforts of Mr. George Grove, under the name it now bears, "The Palestine Exploration Fund." Captain Wilson, who had completed his survey, was again sent out, in company with Lieutenant Anderson, and the exploration of the country was commenced in earnest. In 1867 Captain Warren commenced the excavations in Jerusalem itself, the progress of which was watched with great interest by the public, and resulted in adding largely to our knowledge of the subject and deciding several weighty problems concerning the sites of the Holy Sepulchre and the Temple. In 1869–70 Mr. (now Professor) E. H. Palmer, accompanied by Mr. C. F. Tyrwhitt Drake, made a journey of exploration through the Desert of the Exodus for and at the expense of the Fund. On his return the survey of Western Palestine was commenced and continued till its completion last year. Mr. Tyrwhitt Drake, who had an extensive acquaintance with the Arabic language and manners, accompanied the officers in the field and afforded most valuable aid in obtaining the correct nomenclature and other information from the natives; his death at Jerusalem in 1874 was a great loss to the society and to geographical science. M. Clermont Ganneau, a well-known

French archæologist, was also employed for a long time by the society and his labors in the country are of the greatest practical importance. The archæological and philological information obtained by these gentlemen is embodied in the work of the Society and immensely increases its value.

It must not be imagined that with the publication of the map and memoirs the work of the Society is at an end. Much that is very important remains to be done, especially the survey of the country east of the Jordan (of which an American association has already completed a reconnaissance map), and the exploration of the cities and remains of the Hittite Empire. The work produced by the Palestine exploration fund during the fourteen years of its existence is of such a character as to merit the continued support of all those who are interested in explorations that yield so much that is important to religion, history, and science.

THE ASCENT OF CHIMBORAZO.

The *Panama Star and Herald* of the 12th ult. publishes the subjoined translation of a declaration made by one of two Ecuadorians who accompanied Mr. Whymper on his second trip up the mountain, which (says that journal), in addition to the word of an English gentleman and the evidence of his companions, ought to be satisfactory to all doubters. The declaration, which was written in French, is interesting as containing a simple and easy account of a difficult journey, as well as substantiating the verity of the first ascent: "I, Javier Campaña, of Quito, hereby declare that upon July 3, 1880, I accompanied Mr. Whymper to the very highest point of the summit of Chimborazo. We were also accompanied by Jean-Antoine Carrel and by Louis Carrel (Mr. Whymper's two Italian mountaineers), and by David Beltram, of Machachi. Mr. Whymper placed his tent on July 2, 1880, on the northwest side of Chimborazo, at a height, so he tells me, of about 16,000 feet, and he provided for the use of myself and of David the things which were necessary for an ascent—namely, good, strong boots with large nails, warm gloves, spectacles to protect the eyes against the glare of the snow, and ice axes to help us along. We started from the tent at 5:15 on the morning of July 3, 1880, and at once commenced to ascend toward the summit. The way at first was over loose stones, but after we had ascended for about 1,000 feet we came to snow, and the remainder of the ascent was entirely over snow, with the exception of one or two little places, where rocks came through the snow. We stopped to eat on one of these little patches of rock at 8:35 a. m., and after Mr. Whymper had examined his mercurial barometer he encouraged us to proceed by telling us that we had already got more than half way up from the tent. From this place we saw the sea. We went on again at 9:05 a. m., and found the snow get steeper and steeper. We were all tied together with good strong rope in case any one should slip, and except for this and for things with which I had been provided we would not have been able to get along at all. Sometimes it was very cold and there was much wind, but when we were in the sun it was very hot. Whether in the sun or in the shade the snow was very soft, and we sank in deeply, often up to the knees. This was very fatiguing, and it was owing to this that we took so much longer time in ascending the upper than the lower part of the mountain. To break the ascent we zig-zagged about, and at one time came round to the side fronting Guaranda, and then came back to above the place where the tent was pitched. At last we got on to the top and could see the two summits. The snow was very soft indeed here, and we went along very slowly, and had often to stop to get breath. The higher of the two summits was on our left hand—that is, upon the north side of the mountain—and we went to it, without going upon the lower one. As we approached the very highest point we saw that there was something strange upon it, and when we got up we found the pole of the flag which Mr. Whymper had put up on January 4, 1880. It stood up about 1½ varas above the snow, and very little of the flag remained, as it had been torn to pieces by the wind. I took a small piece of the flag to show to my friends below, and was filled with joy at being the first Ecuadorian to reach the summit of the great Chimborazo. We arrived at the very highest point of the summit at 1 : 20 p. m., and about the same time ashes from Cotopaxi began to fall. They filled our eyes, noses, mouths, and ears, and made the snow quite black. Mr. Whymper, however, prepared his instruments, and was at work during the whole time we were on the summit. He did not once sit down from the time we left the tent in the morning until the time that we returned to it in the evening. He took the height of the mountain with his barometers, and told us that the observations that he now made agreed very well with those which he made upon the first ascent of Chimborazo, on January 4, 1880. At 2 : 30 p. m. we left the summit, and came down as fast as we could, only stopping a little from time to time to allow Mr. Whymper to collect rocks at various places. We arrived again at the tent at 5 : 10 p. m., and found it covered with the ashes from Cotopaxi, which were still falling, and filled the whole valley with a thick cloud. On the 4th of July we continued the tour of the mountain, and arrived at night close to Tortorillas; and on the 6th we returned to Riobamba, having had a most successful journey, without accidents of any sort whatever, not only having made the tour and the second ascent of Chimborazo, but having also made *en route*, on the 29th of June, the first ascent of Carihuairazo. FRANCISCO J. CAMPAÑA.—Guayaquil, July 19, 1880.—Declared and subscribed at Guayaquil, this twentieth day of July, 1880, before me, GEORGE CHAMBERS, Her Britannic Majesty's Consul, Guayaquil."

SCHWATKA'S ARCTIC SEARCH.

AMERICAN AND ENGLISH METHODS OF ARCTIC EXPLORATION.

The *Herald* editorially sums up the results of Lieutenant Schwatka's sledge journey over 3,000 miles of snow, as follows:

"In a field that seemed to have been already overworked, in which so many hardy adventurers before him had done their utmost to wrest the secret of Franklin's fate from the icy grasp of the polar world, Schwatka went as a late gleaner, and gathered an amount of information that greatly increases the general capacity to understand the story of Franklin's fate. Admiral McClintock, whose own name is famous in the story of Arctic exploration, puts his finger on an important point made clear by Schwatka's experience. Admiral McClintock says: 'What I regard at this moment as the most striking feature of the report you have read for me is the success of Lieut. Schwatka's plan of living on the produce of the land through which he traveled. It is that that distinguishes his expedition from others. All other explorers making sledge journeys have relied chiefly on the supplies carried with them. The Schwatka party, according to this report, was nearly a year absent from its base of supplies, and took only one month's food with it. In adapting themselves to the life of the natives, as they did, Lieut, Schwatka and his followers accomplished something remarkable. This point is fully worthy all the importance that the Admiral gives it. Here is a party of men who go from an American city with infinitely less of the apparatus of Arctic adventure than is usual, making sledging the great element of their operation, live with the Esquimaux as much as they can, accustom themselves to the habits of life and the diet of this mild savage, and they live and are at their ease, and come and go, and are in every way successful in that very district in which the last of Franklin's men perished in the Arctic summer. This contrast presents in the most notable way the difference between two widely varying methods of exploration—methods that may be called respectively the English method and the American method. The Englishman starts with a resolute will to be all and do all; he has a robust self-sufficiency that is the basis of great successes and the limits of whose usefulness he does not recognize. One may read a great many English volumes of Arctic discovery and rise from the perusal with the imagination that all that polar world is a void, an absolutely unpeopled region. On the other hand, the American is adaptable, and is ready to use for his purpose whatever elements present themselves. He makes use of an encampment of Esquimaux to help him over a difficulty just as he would make use of a turn of the tide to move his boat out of a bad place. He divides Nature and uses one part of her forces to overcome the other, and the Esquimaux are forces that Nature has put within his reach. And from an American narrative of how men get on in the Arctic world we rise with the imagination, not that it is an uninhabitable region, but that it is only another part of the Indian country, and that the Esquimaux are unusually placid and tractable

Indians. In this contrast lies an important secret that should be kept in view in all future Arctic operations.

"After reaching from Hudson's Bay, his destination on King William's Land where Franklin's party were known to have perished, the shore was minutely examined by Lt. Schwatka, where the Erebus and Terror remained from September 1846, until abandoned in April, 1848, and how much longer it is not possible to say precisely, though the correspondent recounts some now newly-discovered facts that bear on that point. On one of the ships there beset Sir John Franklin died in June, 1847, and in the weary eighteen months of icy desolation through which the ships were there held immovablc the patience and hope of all on board gave way, until they were tempted to abandon the yet sound and well-provided ships and try a desperate homeward adventure by boat and sledge. They had actually made the discovery of the Northwest Passage; their ships were in a channel which when open was continuous from Behring's strait; but they had lost hope and heart and wandered away from their wooden walls to perish miserably on the shore.

"From an old Esquimau, of 65 or 70 years of age, the explorer obtained a clear account of the fate of at least one of the ships. This native reports his encounter with a party of white men, who were apparently of the Franklin expedition, and his subsequent visit to a ship frozen in the ice five miles west of Grant Point. She was watched for awhile, it appears, and no one was seen near her, and as the Esquimaux saw no signs of life they ventured near. They found one dead man in a bunk—the second time the speaker had seen a white man. They used to go on board to steal small articles. Not knowing how to get down below they cut a hole in the side of the ship on a level with the ice, and through this the water got in the next summer and sent her to the bottom. That must have been the summer of 1848. In that year, therefore, within a few months after Franklin's men had abandoned the ships, the ice around them broke up.

"The correspondent writing up the history of the journey states that during the year 2,819 geographical miles, or 3,251 statute miles were traveled, for the most part over unexplored territory, constituting the longest sledge journey ever made, both as to time and distance. Indeed the journey stands conspicuous as the only one ever made through the entire course of an Arctic winter. The party successfully withstood the lowest temperature ever experienced by white men in the field, recording one observation of 71 degrees Fh.; 16 days whose average was 100 degrees below the freezing point, and 17 days which registered 60 degrees Fh., during most of which the party traveled. In fact there was a halt of only one day on account of the cold.

"It is claimed for this expedition that it was the first to make a summer search over the route of the lost crews of the Erebus and Terror, and while doing so buried the remains of every member of that fated party found above ground. The search, it is considered, has established the fact that the Franklin records have been irrecoverably lost at the boat place in Starvation cove. 'The search for relics of Sir John Franklin's party had one negative result of great importance, as it extinguishes the hope of any further discovery of written records. They were told that the Natchilli Esquimaux had found a tin box, one foot square and two feet long, containing books, at a point near Back's river, the place where the last of the Franklin party probably perished. The box was found and opened by the natives not long after the death of the white men, that is to say, thirty years ago. The most careful search failed to bring to light any of its contents, which were most likely the written records of the Franklin expedition, and there is hardly a doubt that they were long since irreparably lost or destroyed. They ascertained that the cairn mentioned in Capt. Barry's story has no existence. It is evident, then, that the history of the expedition up to the time of Sir John's death, the particulars of his illness, the story of the wanderings of the crews after they deserted the Erebus and Terror, and many other things that we would most like to know, must forever remain enveloped in mystery.

CHEYNE'S PROPOSED EXHIBITION.

Commander Cheyne is vigorously at work raising subscriptions for his proposed new expedition to the Pole, the cost of which he estimates will be about £30,000. According to the London *Times* it is not improbable that the co-operation of Canada will be invited. By adopting a course of lectures, illustrating Arctic work by means of the lime light, Commander Cheyne has succeeded in establishing an influential central committee in London, and upward of sixty branch committees in England, Scotland, and Ireland, for carrying on a collection of subscriptions, the work being on a voluntary basis. The sum of £1,890 has been secured in London already, in cash and written promises; Captain Bailey, R. N., has brought into the fund £264, besides making a present of a six-man sledge; Messrs. Forrest, the boat-builders, have promised another sledge and £150 worth of limejuice, and limejuice biscuits have also been promised by Messrs. L. Rose & Co. Various other articles are forthcoming in the shape of medical comforts, etc., and Dr. B. W. Richardson, F. R. S., has undertaken to superintend the proper provisioning of the vessel. Mr. John M. Cook has generously given the committee a commodious office, rent free, and has under his consideration a plan for sending a steamer as far as Disco, or Upernavik, taking a party of excursionists and conveying surplus stores across the Atlantic for the expedition, thus saving the expense of hiring a vessel for transport service. Taking all these favorable circumstances into consideration, it has been determined to give notice of a motion to be brought before Parliament early next session, asking for a small Parliamentary grant in aid of this volunteer movement. Support of such a motion is already assured on both sides of the House, there being happily no political bias in the question of our Arctic prestige.

A deputation of the London Central Arctic Committee waited, on the 27th of August, upon Sir John Macdonald, the Premier of the Canadian Dominion, who promised the members that the case of joint action should be submitted for favorable consideration upon his arrival in Canada, as the Canadians took a great interest in the enterprise. Moreover, Commander Cheyne is prepared, in the event of necessity, to reduce his estimate to £20,000, which could be accomplished by taking a smaller vessel, with a reduced complement of thirty officers and crew. With this end in view the Arctic Committee will endeavor to charter from Dr. Oscar Dickson the Vega, lately returned from a successful accomplishment of the northeast passage, under Professor Nordenskjold. This vessel has just been put into thorough repair, and may now have an opportunity of doubling her fame by the circumnavigation of Greenland, in addition to carrying the Union Jack for a contemplated installation at the Pole.

THE CRUISE OF THE STEAMER CORWIN IN ARCTIC WATERS.

The following is the text of a letter received at the Treasury Department from Captain Hooper, of the Corwin:

"*U. S. Revenue Marine, U. S. Steamer Corwin*, St. Michael's, Norton Sound, Alaska Territory, July 10, 1880.—Hon. John Sherman, Secretary of the Treasury, Washington, D. C.—Sir: I have the honor to report our arrival at this port on the 7th inst., after a short cruise in the Arctic ocean. We sailed from here on the 23d of June, and on account of large quantities of ice in the sound to the northward, worked out through the southward and crossed over Behring sea, along the north side of St. Lawrence Island, touching at several places on the Island to inquire into the condition of the natives, and at Plover Bay, Asia, where we took on board about twenty-five tons of coal belonging to the Russian Government. From there we proceeded north, touching at several places on our way, and entered the Arctic ocean on the 28th of June. We have communicated with the natives on the east and west side of Behring's Straits, and as far north as Point Hope, on the American side, and Cape Serdze Kaman, on the Asiatic side. We have also communicated with most of the Whalers now in the Arctic, but can get no tidings of the missing ships. The whalers, without an exception, give as their opinion that nothing will ever be heard of them. We have followed the ice-pack around from Cape Serdze Kaman across the Arctic to Point Hope, and down to Cape Prince of Wales, getting as far north as sixty-nine degrees. The past winter, although very severe south of the straits, appears to have been comparatively mild within the Arctic circle. The whalers all pronounce the ice as unusually light. After following the ice-pack around and finding it impossible to get further north or approach the land near enough to find a harbor, we returned to this place on the 7th for the purpose of filling up with coal, cleaning boiler, etc. This work has been completed and we sail at meridian for the Arctic *via* places on the north side of the sound, which we could not visit before on account of the ice. Kotzebue Sound was full of ice when we came out, but I hope to find it clear on our return. As soon as we can get in there I shall detail an officer, with an armed boat crew, to keep a sharp look out for whisky traders, and go north again as far as Herald Island to continue the search for the whalers. I hope to reach Wrangel Land by the middle of August or first of September. We were within 140 miles of it on our recent cruise. The Corwin works entirely satisfactorily in every way, and all hands are in good health and spirits, and everything on board harmonious. I shall mail this by the schooner, Western Home, belonging to the Western Fur and Trading Company, which leaves for San Francisco in a few days, touching at several places on the mainland and Aleutian Islands on the way down. I am, very respectfully, your obedient servant, C. L. Hooper, Captain U. S. R. M.

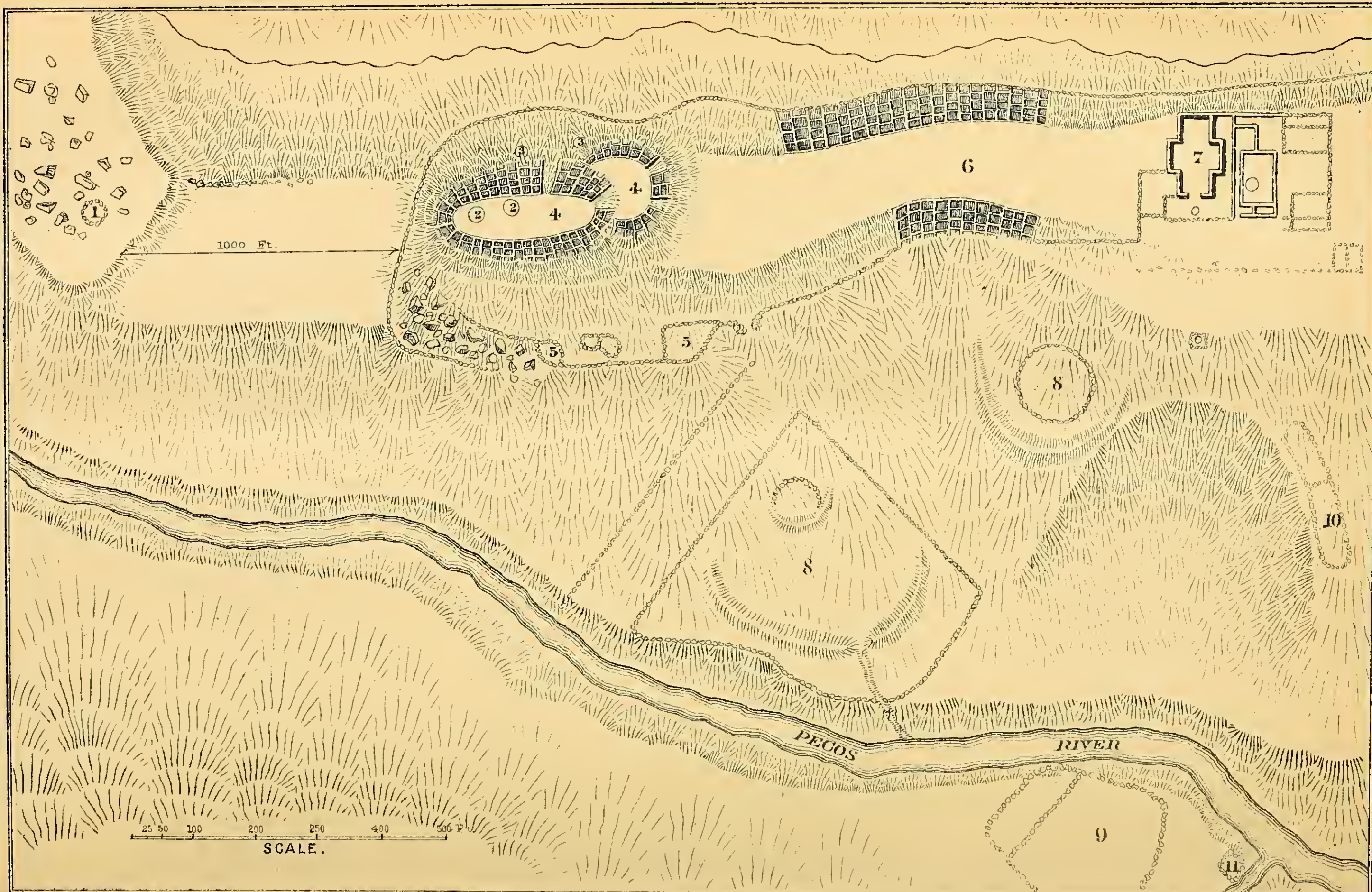
THE HOWGATE EXPEDITION.

The Arctic steamer, Gulnare, arrived at St. Johns, N. F., September 25, having turned back at Disco, Greenland. One of her officers reports as follows: "After leaving St. Johns the weather was fair until August 2, when we were caught in a southwest storm which drove us within a few miles of Cape Farewell. A large hole was smashed in the stern and the larboard boat swept away, the bulwarks stove in and the deck load of lumber, intended for the house to accommodate the party to be left in the Arctic, was washed overboard. We arrived in Disco on September 8, and remained until the 21st, repairing damages. We went to the coal mines above Rittenbank, but found much difficulty in coaling on account of their being no anchorage and much ice in the Waigatt. We left for St. Johns with an insufficient supply of coal and sailed most of the way. All are well on board."

Dr. Pavy and Mr. Clay remained at Rittenbank, where they will winter and prepare for the work of next year. The whole ship's company are in good health and condition, and suffering from nothing more serious than the natural disappointment that follows after baffled hopes.

LIEUTENANT DOANE'S REPORT.

St. Johns, N. F., September 25, 1880.—Captain H. W. Howgate: The Gulnare returned last evening. Lost one boat and all the deckload in a gale on the 31st of August. Reached Disco on the 8th with two planks loose, and stove in starboard quarter. Till 21st repairing. Took two weeks to coal half supply. Came in here mostly by sail. Pavy and Clay remained at Rittenbank. No casualties. Doane.



Ramsey, Millett & Hudson, Lith. Kans. City.

ARCHAEOLOGY.

A HOLIDAY EXCURSION BY RAIL TO THE BIRTH-PLACE OF MONTEZUMA.

THEO. S. CASE, KANSAS CITY, MO.

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Arrived at Baughl's station, on the Atchison, Topeka and Santa Fe rail road, which is no more than a siding where rail road ties are received and handled, and which simply consists of a boarding car and two saloons, we started on foot for the scene of our explorations, about one mile and a half distant. Before entering upon a description of the ruins found here, I will say that notwithstanding the volumes that have been written by the explorers of this central portion of the Western Hemisphere, descriptive of its past civilization, the vastness and perfection of that civilization have been by no means comprehended. Every day the hardy and venturesome prospectors of New Mexico, who, like the Spaniards of the sixteenth century, are urged on by an ardent quest of precious metals, discover new evidences of the existence in prehistoric times of a race of men who, in architecture, agriculture and metallurgy, possessed a degree of knowledge and skill hardly surpassed in any age.

The discoveries of these explorers also go far to prove that the land which is now so utterly unproductive, was once sufficiently arable and prolific of vegetation to support a dense population, and that the various reasons which are proposed by the writers of the present day to account for the abandonment of the country by these people, such as superstitious fears, the aggressions of hostile tribes, etc., are futile and unsatisfactory.

It seems unquestionable that some vast change took place in the geological and physical condition of the country, causing its fountains to dry up, and changing its fertile valleys into arid wastes, thus literally starving the people out and forcing them to seek new homes. This idea brings to the front the theory and tradition of the Continent of Atlantis with more plausibility than almost any other: a theory which, if established, will enable us to account for the migration of ancient peoples from one continent to the other without tasking our credulity with the extremely doubtful one of the Behrings Straits route.

Before we had proceeded more than half a mile we came into view of the church and ruins of Pecos, lying on a beautiful plateau on the further side of the Pecos river, and separated by a narrow valley from a commanding range of mountains several miles beyond. This plateau seemed to be completely surrounded by mountains; those on the west being grand in their outline and crowned by a bald peak, which appeared exactly adapted for a watch-tower for the people of the city on the plateau, and perhaps for an outlook for the priests of the sun, who from its lofty summit, could catch his earliest rays long before they would be visible to the people below. The whole valley, from mountain range to mountain range, is about five or six miles, while it seems to be inclosed at both ends by purple ranges, about ten miles apart, with an occasional snow-capped peak. Thus apparently hemmed in on all sides, and in the midst of what was probably in the day of their prosperity a luxuriant and fertile plain, these ancient people built their singular houses and lived peaceful and quiet lives. The evidences of their civilization are found in abundance, in implements for grinding corn, pottery evincing various degrees of skill, and in some places in pictured rocks and decorated caves.

These houses are very much alike in all the villages that are known, being built against the sides of bluffs or rocky acclivities, one story above another to the height sometimes of five to six or seven stories. The material used is stone, cemented together and sometimes coated or plastered on the outside, with mud. The first story has no opening except at the top, which is reached with a ladder, while the other stories have doors opening from the roofs of those below. Within, or at least in the lower or basement stories, there are connecting openings from one to another. The stories are separated by floors of timbers laid together and sometimes bound together with withes. Remains of corner-posts made of pine and cedar poles are found abundantly in their proper position.

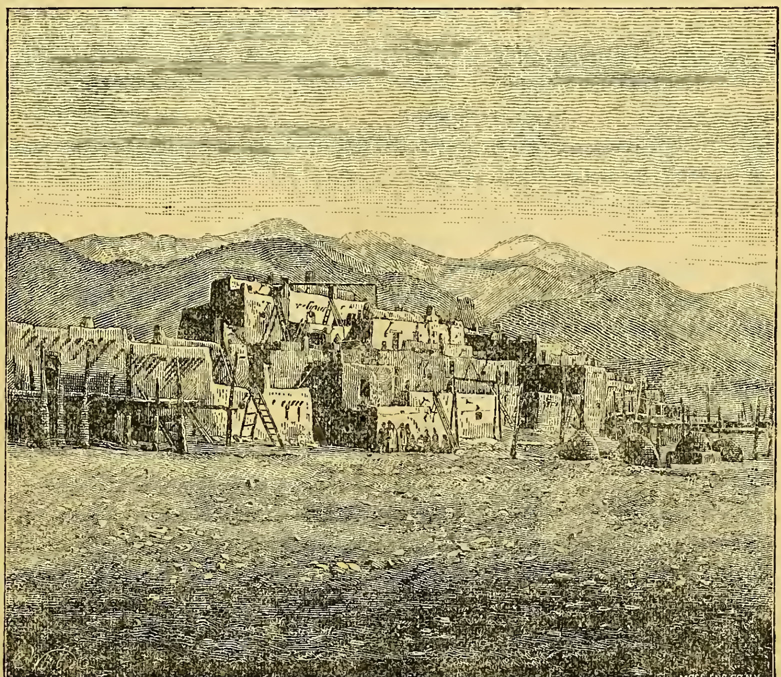
The system of walls and outworks is very extensive, but whether it is all of the same age as the village, is more than I was able to determine. Commencing at the western end of the plateau, the first evidence of the hand of man that I discovered, was a circular stone wall inclosing a space thirty feet in diameter. (1 in plate.) This is located upon a rocky point some fifty feet above the adjacent ground, and commands a view of the valleys on both sides, as well as of the plateau beyond, upon which the village is built. From all indications this was a fort or lookout tower. (W. H. Holmes in Bulletin No. 1 of the United States Geological and Geographical Survey of the Territories, vol. II, 1876, describes the ruins of a tower found in the Mancos cañon in Colorado, probably similar to this, whose outer dimensions were forty-five feet in diameter and twelve feet in height at the highest point of the wall yet standing, which is twenty-one inches in thickness. It was doubled walled, with apartments between the outer and inner walls.

On the *mesa* above the bed of the River McElmo, a square shaped tower was discovered standing in on the summit of a great block of sandstone, forty feet high and detatched from the bluff back of it.

At another place on the McElmo, the ruins of a triple-walled tower were found, with sectional apartments between the outer and second walls, and such towers abound on prominent points all along the Gila, Chaco, Rio Grande and other rivers of Colorado and New Mexico.) Proceeding eastwardly, we descend from this point some twenty feet or more to a long and narrow passage of bare rock, not less than 1000 feet long, by an average width of about one hundred feet. On the north side, this passage is defended by a stone wall running along the edge of the rock for a distance of about 300 feet. For the remainder of the distance to the foot of the bluff upon which the ruined village is built, there is no sign of any work done by man.

At the foot of the bluff just mentioned, we come upon the remains of a stone wall which runs around both sides of the plateau from village to church, being in its whole length not less than 2000 feet. This wall seems to have been intended for defense, as it is located on the extreme edge of the plateau, all around, just where the steep and almost perpendicular declivity begins.

Commencing here, we are amazed at the size of these ruins. (4.) The buildings were commenced at the foot of the bluff, the rooms of the first story being, say, 8x10 feet and about 7 feet in height. The rooms on this floor have no doors in the side-walls, but are entered from the roof, which is reached by a ladder. Upon this story another is built which sets back from the front of the first, and like it leans against the side of the bluff. This story has doors in the front of the rooms, which are entered from the roof of the lower story. In this way as many as six or seven stories are built one upon another, and the buildings are extended laterally as far as the necessities of the community demand, all united as closely together as cells in a honey-comb.



PUEBLO VILLAGE AT TAOS, NEW MEXICO; NOW INHABITED.

In this Pecos village there were not less than 1000 rooms, and probably many more. I could readily count two hundred rooms at the top, and from four to six stories on the sides of the bluff. The whole group seemed to consist of two irregular circles, the larger of which extended partially around the end of a rocky bluff about thirty feet high above the bare rock just described, rising two stories above its summit and completing the circle or oval upon the surface of the bluff. This circle is two hundred and twenty-five feet across in one direction, say east and west, and seventy in the other, with one opening or passage, say sixteen feet wide, leading down the face of the bluff on the northern side, and one into the inclosure on the east.

This area contains two basin shaped, stone-lined reservoirs, probably for water, twenty-five feet in diameter and more than six feet deep, (2) as was proven by digging into them to that depth without finding the bottom of the stone-lining. They are filled with earth to within some three or four feet of the surface. Outside of the circle of huts, at the foot of the bluff on the north side, but inside of the stone wall above named, are two similar stone-lined, basin shaped reservoirs, sixteen feet in diameter and filled within two or three feet of the surface. (3.) One of these is on each side of the passage-way before mentioned. A very singular thing is, that the western of these reservoirs seems to be connected with one of those inside, by an aqueduct or conductor, constructed wholly of cement made of ashes and some other substance, possibly lime, though no lime or cement of any kind is found in any other part of the works.

This aqueduct is exposed at the margin of the reservoir nearest the bluff and is at least two feet in diameter, with walls not less than eighteen or twenty inches in thickness. It was constructed by making lumps and blocks of the cement, some rounded and some flat, varying from four to ten inches in diameter and laying them upon each other like bricks and fastening them together with layers of similar cement, and finally smoothing the whole over with a coating of the same. I had no implement but an old hatchet, and could do but little in the way of excavating this aqueduct, and may have been mistaken as to its object and purpose, but from its locality and shape, as disclosed by my cutting into it some two feet or more, I think I am correct.

Adjoining the inclosure above described on the east, is a small one, also built around with similar stone huts, two stories high, which is about sixty by seventy feet in diameter and has two gateways, one to the north-east and the other to the south-east., each ten feet wide and thirty-six feet long. To the southward of both of these inclosures and close to the rocky declivity, which is bold and commanding, are several remains of walls and buildings, nothing being left but the foundations and some loose rock. The first or western of these is 24x58 feet, the second 24x27, and the third 10x30. Still further east and on the extreme point of the rock is a triangular shaped inclosure 54x69, the third side being made by the wall on the edge of the bluff. From the situation of these (5), especially the last named, they were evidently for the purposes of defense and outlook.

Just east of the huts last described, the ground slopes rapidly to the east and south, with ledges of bare rock making a kind of wall to the southward and westward. Still proceeding eastwardly we pass over some two hundred feet of bare, smooth rock when we come to two other groups of ruins (6), about four hundred feet in length, one on each side and overhanging the respective bluffs on the north and south sides of the plateau. There are about eighty huts in each of these groups on the summit, making probably about two hundred in all, when averaged at two stories high. They are similar to those just described, being made of stone cemented together with mud, and arranged in rooms of from six to ten feet square, those in the basement story being connected by openings underground. Between these groups of huts the space is nearly or quite two hundred feet wide.

We did not find any rooms among them answering to the description given by several explorers of the *Estufas*, where the sacred fire was kept burning, unless the circular, stone-lined basins, within the court of the larger village, may have been originally covered over and used for such a purpose.

Dr. Hammond, who accompanied Lieutenant Simpson in his United States military reconnoissance in New Mexico, in describing the ruins of Chaco, speaks of sacred *Estufas*, circular in form, excavated several feet deep in the earth and inclosed with circular walls. The fact that no water, except perhaps the drippings from the roofs of the upper tier of huts, could naturally find its way into these basins, gives probability to the suggestion that they may have been constructed for *Estufas*, instead of for storing water.

On the south side of the plateau, about half-way between the first and second village, is a gateway in the outer wall, which in that part is six or seven feet high and from three to four feet thick. This gateway is about ten feet wide, and was apparently made to enable the inhabitants to pass out their stock to graze and to water in the inclosures which will be described a little later.

Having now described nearly everything on the plateau that seems to belong to the Aztec civilization, we will pass out of the gate just mentioned, on to the slope that descends gradually to the Pecos river, which winds its way along at a distance of a few hundred yards to the southwardly.

The first thing which attracts our attention is a long stretch of ruined wall which extends in a south-westwardly direction from a point within about 120 feet from the gate to the bank of the river, 600 feet away. Just beyond the upper end of this wall we find an inclosure (8), walled all the way around, 390 feet by about 120 feet, and banked up with earth at the lower part as if to retain water. Just at the lower corner there appears to have been an artificial outlet through the dam and wall for prudential purposes. Within this inclosure is a circular artificial pond, also banked up with earth, about seventy-five feet in diameter. Just east of this inclosure and a little further up the slope is another (8), apparently constructed for the same purpose, being nearly as large and banked up across the lower part in a similar manner. Within this, also, is a smaller circular pond 120 feet across, which even at this time was muddy in the center, although it did not contain any water.

Still proceeding eastwardly, there are traces of walls and apparent foundations of buildings all along the slope, and on a little eminence about 200 yards southeastwardly of the inclosure last described are the remains of two walls (10) inclosing spaces respectively 100 feet square and 125 x 140.

On the opposite side of the Pecos river, between it and a small stream which empties into it, and 345 feet southeast of the water inclosure first above described is a kind of pentagonal inclosure 240 feet in diameter (9) and crossed by another wall which divides it into one large and one very narrow compartment. Just beyond and southeast of this are the remains of what has apparently been a fortification, situated just at the confluence of the two streams.

This completes the description of the outside works. We will now return to the plateau. Passing from the groups of Aztec huts last described, we proceed eastwardly 180 feet and find ourselves face to face with the old Pecos church itself. Before describing this old building (7), we will refer to the history of the discovery of the village, which had its origin long before the Spanish invasion, and which is held by the Aztecs to have been the birth-place of Montezuma himself.

There seems to be no doubt that the Aztecs migrated from some more northern region, into Mexico, and the traditions of the present Pueblos, who are believed to be descendants of the original Aztecs, teach that this very spot was the birth-place of Montezuma. But Short, in his "North Americans of Antiquity," claims that this is a different civilization and that the culture-God Montezuma of the Pueblos and the Aztec monarch, Montezuma, are not to be confounded. Dr. Foster, in his "Prehistoric Races of America," does not speak of any such distinction. At all events, all writers agree that Pecos is one of the most important of all the ancient ruins of this region, and that it was one of the sacred cities of the Pueblos. Here the everlasting fire, dedicated to their god Montezuma, was kept burning from time immemorial down to the abandonment of the town, which occurred, according to Short, some time during the second quarter of the present century. Other authorities fix the year at 1837.

One tradition is that Montezuma was born at Acoma, and subsequently removed to Pecos, where he taught the people the arts of civilization, and that when he removed to the South he told them to keep the sacred fire burning until his return. But he never came. Warriors watched the fires and remained on duty by turns, until through decimation from one cause and another, the tribe became too much reduced in numbers to keep up the watch any longer. Then three warriors took the remains of the fire and carried it into the mountains, where Montezuma himself appeared and received it Thus relieved, they abandoned their village and joined their brothers west of the Rio Grande.

"For generations," as Short eloquently says, "these strange architects and faithful priests waited for the return of their God—looked for him to come with the sun, and descend by the column of smoke which rose from the sacred fire. As of old the Israelitish watcher upon Mt. Seir replied to the inquiry: "What of the night?" "The morning cometh," so the Pueblo sentinel mounts the house-top at Pecos, and gazes wistfully into the East, for the golden appearance, for the rapturous vision of his redeemer, for Montezuma's return, and though no ray of light meets his watching eye, his never failing faith, with cruel deception, replies "The morning cometh.""

In about 1540 Coronado, the Spanish governor of New Spain, lured by the resistless rumor of boundless wealth of gold and silver, which no Spaniard could withstand, led an expedition to this very village, then called Cicuyé. The Pecos river must have been a far larger stream than at present, as Coronado found it frozen over with ice strong enough to bear up his horses. He found the settlement of Cicuyé extending along the river for six miles, and the soil extensively cultivated by the Indians. It was from that time that the decline of the tribe commenced. The date of the building of the church is not exactly known, but it was probably very soon after the invasion by Coronado, for zeal in religious matters was next to lust of gold in the heart of the Castilian in all of his conquests.

We may imagine that the gentle and tractable Pueblos were speedily induced by their enthusiastic conquerors, to embrace Christianity, and that the building of this church was a work of fear of temporal power, rather than of faith in and love of the deity represented by the Spaniards. It was constructed of adobes, which are about sixteen inches long, twelve inches wide and three inches thick. Its shape is that of the Latin cross, its walls six feet thick and its dimensions one hundred and forty feet long by forty feet wide; the transverse portion being fifty-seven by thirty-five feet, and its original height about thirty feet. There were several smaller rooms attached on each side, and possibly a building of considerable dimensions on the west side, as there are traces of adobe walls which indicate either a building or an inclosure divided into several smaller rooms or lots. I have in my possession a book published in 1854, containing an engraving which represents the church as having a building on the west side. I could find nothing in the appearance of the ground to indicate anything of the kind, either in the way of rubbish or otherwise, and it seems to me, if the church itself could so well withstand the ravages of time, any adjoining buildings would have endured as well. The roof of the church has been nearly gone for many years, and the side-walls of the front end are also crumbled away nearly to the ground. The rear portion is nearly at its original height, and some of the cross-beams with their rude carvings, remain *in situ*. The others have been cut away by curiosity hunters

The adobes of which the building is constructed, are made of a reddish clay containing small pieces of pottery of a ruder and coarser order than that found about the Pueblo villages. In one of these inclosures just west of the church is a small excavation about twelve feet in diameter, evidently the remains of a water-reservoir. Immediately in front of the entrance and about forty feet from it, is what seems to be an old well, which had been walled up with stone and has been more recently filled up with earth.

About seventy-five feet still further on, we come to the traces of an old wall terminating on the East in the ruins of several small rooms or inclosures, also of stone. About eighty feet still further and directly in front of the entrance to the church, is an inclosure about eighteen feet square, with a central stone heap about three feet square. Still further in the same direction we find a semi-circular declivity, which was probably originally the work of man, which terminates on the right at the water inclosure described on page 423, and on the left at the stone inclosures described on the same page.

In speaking of walls, it is to be remembered that most of them are ruins and many of them mere traces, although readily discernible as one walks over the ground.

Leaving the church for the present, we will turn back to the ruined villages in search of relics. Broken pottery abounds on all hands, and it seemed to me that I could detect specimens representing at least three distinct periods of time: First and oldest, that found in the adobes of which the church is built, which is coarse and rough; second, that which is made of finer clay, but without ornament, and lastly, that which is painted; and perhaps fourthly, that which shows an effort at glazing.

We found numerous flint arrow heads, all of which were small, none being over one and a half inches in length. Perhaps this is due to the fact that the larger ones have been picked up by earlier explorers. We also found several broken *metatas*, or grinding pestles, and in one of the large rocks near the upper village, I found three bowl-shaped cavities, about ten inches in diameter and from three to four inches deep, which I conceived to be the mortars in which the natives ground or beat their corn into meal.

We also found numerous pieces of obsidian which appeared to have been split off in keen flakes for cutting purposes; also fragments of smoking pipes with more or less ornamentation cut or scratched upon them. Besides these things, we discovered smaller ornaments, in the way of shells pierced for suspension, pieces of selenite roughly carved into ornamental shapes and small bits of red paint. Not a scrap of iron or any kind of metallic weapon, tool or implement could be discovered in either church or village—not even a nail—though it is well known that the natives understood the art of smelting ores, at least those of silver and gold, and of working them most artistically. If other proof of this knowledge were wanting, we could supply it in the form of several pieces of slag picked up near the villages; and the people who reside near say that remains of old smelting works are still to be found in the mountains.

Parts of three days were given to this exploration, in company with Mrs. Case, Major H. Inman of Kansas, and Mr. A. H. Whitmore of Las Vegas, all of us being greatly interested and more than willing to devote much longer time and labor to a more complete examination of these ruins, should another opportunity present itself when we were better prepared to do them justice.

A great many more most interesting things were seen by us in New Mexico, but the limits of this paper have been reached, and an account of the remainder must be postponed until another time, with the closing suggestion, that had these industrious and ingenious natives not been disturbed and driven out by the thriftless and avaricious Spaniards, who have never improved any country by their conquest of it, they would in all probability have built up the ruling empire of North America, and thus at least have kept alive the fire of civilization kindled by Montezuma—the culture God—in their minds, until the day of his return, in the millenium.

ASTRONOMY.

PLANETARY PHENOMENA FOR NOVEMBER, 1880.

BY W. W. ALEXANDER, KANSAS CITY.

Mercury sets on the 1st at 5 h., 54 m., p. m., and rises on the 30th at 5 h., 50 m., a. m., and is in inferior conjunction with the sun on the 23d.

Venus sets on the 1st at 6 h., 23 m., p. m., and on the 30th 6 h., 57 m., p. m.

Mars rises a few minutes before the sun, but is too near that luminary to be seen.

Jupiter sets on 1st at 4 h. 10 m. a. m., and on the 3th at 2 h. 7 m. a. m.

The following is a brief summary of the phenomena presented by its four moons, Io, Europa, Ganymede and Callisto, the time used being Kansas City mean solar time:

On the 1st, from 5 h. 52 m. to 8 h. 6 m. p. m. Io will be making a transit of Jupiter's disk.

On the same day from 6 h. 31 m. to 8 h. 45 m. p. m. Io's shadow will likewise pass in transit.

On the same day from 7 h. 57 m. to 9 h. 37 m. p. m Europa's shadow will be making a transit. Europa will egress from a transit at 8 h. 20 m. p. m.

On the 2d at 5 h. 59 m. 17 s. p. m. Io will reappear to the east of the planet at the end of the eclipse.

On the 3d at 6 h. 51 m. p. m. the shadow of Ganymede will end a transit.

On the 7th at 10 h. 26 m. p. m. Io is occultated and disappears.

On the 8th from 7 h. 38 m. to 9 h. 52 m. p. m. Io will be making a transit.

On the same day from 8 h. 26 m. to 10 h. 40 m. p. m. the shadow of Io will make a transit.

On the same day from 8 h. 1 m. to 10 h. 40 m. p. m. Europa will be making a transit.

On the same day at 9 h. 36 m. p. m. the shadow of Europa will commence a transit which will last until after midnight.

On the 9th at 7 h. 54 m. 55 s. p. m. Io reappears at the end of an eclipse.

On the 10th at 6 h. 28 m. p. m. Ganymede will egress from a transit.

On the same day at 6 h. 45 m. 38 s. p. m. Europa will reappear at the end of an eclipse.

On the same day from 7 h. 22 m. to 9 h. 52 m. p. m. the shadow of Ganymede will be making a transit.

On the 15th from 9 h. 26 m. to 11 h. 39 m. p. m. Io will be making a transit.

On the same day at 10 h. 22 m. p. m. the shadow of Io begins a transit which lasts until after midnight.

On the 16th at 6 h. 40 m. p. m. Io disappears by being occultated, and reappears from being eclipsed at 9 h. 50 m. 38 s. p. m.

On the 17th at 6 h. 6 m. p. m. Io ends a transit, and at 7 h. 4 m. its shadow likewise leaves the disk of Jupiter.

On the same day from 7 h. 27 m. to 10 h. p. m. Ganymede will be making a transit, and at 11 h. 25 m. its shadow will begin to make a transit.

On the 23d at 8 h. 29 m. p. m. Io is occultated and disappears, and reappears after being eclipsed at 11 h. 46 m. 26 s p. m.

On the 24th from 5 h. 40 m. to 7 h. 55m. p. m. Io will be making a transit, and from 6 h. 46 m. to 8. h. 59 m. its shadow will likewise pass across the disk of Jupiter.

On the same day at 7 h. 10 m. p. m. Europa will disappear by being occultated, and reappear from an eclipse at 11 h. 57 m. 19 s. p. m.

On the same day Ganymede begins a transit at 10 h. 59 m. which lasts until after midnight.

On the 25th at 6 h. 15 m. 21 s. p. m. Io reappears at the end of an eclipse.

On the 26th at 6 h. 54 m. p. m. the shadow of Europa ends a transit.

On the 28th at 5 h. 27 m. 38 s. p. m. Ganymede disappears by entering the shadow of Jupiter and reappears coming out of the same at 7 h. 40 m. 46 s. p. m. Both the disappearance and reappearance happen at some distance to the east of Jupiter.

On the 30th at 10 h. 20 m. Io is occultated.

Saturn sets on the 1st at 5 h. 14 m. a. m., and on the 30th at 3 h. 10 m. a. m.

Uranus rises on the 1st at 1 h. 48 m. a. m., and on the 30th at 11 h. 55 m. p. m.

Neptune rises on 1st 5 h. 10 m. p. m., and on the 30th sets at 4 h. 51 m. a. m.

Our moon begins its monthly course by passing the Sun on the 2d and Mercury and Venus on the 5th. On the morning of the 13th it will pass north of Jupiter 7° 7′ of arc.

On the evening of the 15th at 5 h. 30 m. it passes north of Neptune 5° 41′ of arc.

It also occultates eleven stars during the month visible at Kansas City.

APPLIED SCIENCE.

THE TELEGRAPH AS APPLIED TO THE FISHERIES IN NORWAY.

TRANSLATED FROM LA LUMIERE ELECTRIQUE, BY MISS IDA HOWGATE.

The International Fish Exhibition which has just closed at Berlin has called attention to the results obtained from the application recently made in Norway of the electric telegraph, for the benefit of the coast fisheries.

The *Revue de l' Union des telegraphes anstro allemands* has already spoken, in 1866, page 298, of the commencement of this work; but, to-day we are able to give more fully, some details of its development and of the activity in business resulting from its introduction.

All the telegraphic stations which are connected with the fisheries, and with the sale of their products, are situated at the north of Drontheim. The first telegraph for fishery was established in 1861. At first there was a single local line in Loffoden, but, in 1868 it was attached to the general telegraphic system by a wire 690 kilometers in length, going from Brettesnaes to Namsoes, and uniting with a line (Namsoes-Drontheim) already constructed.

The Loffoden line was extended, in 1869, to Tromsoë, and, in 1870 it reached, in passing through the most northerly cities of the country, Hammerfest, Vadsoe, and Vardoe, as far as the banks of the Glacial sea. From 1870 to 1877 the principal line was completed by the addition of numerous lateral lines, and by a prolongation, passing by Vardoe, along the coast of the Glacial sea as far as Berlevaag. The entire length of the wire-work in the northern fishing districts comprises 3,595 kilometers of line, and 5,190 kilometers of cable, thereby increasing the expenditure to 2,600,000 crowns.

In view of the serious accidents to which telegraphic conductors are liable in Arctic regions, on account of the climacteric influences, especial precautions have been taken to protect them from exposure. The operators at first use, as conductors, a group of three iron wires, three millimeters in diameter, twisted so as to represent one solid wire 5.2 millimeters in diameter. On the most inaccessible mountains, a steel wire 0.7 millimeters in diameter, has been added to this conductor, to be used in case of accidents. The soldered points are made secure by strong joining muffs.

Among the telegraphic lines mentioned, those found along the coasts near Stavanger and Bergen are devoted principally, in winter and spring, to herring fishing, which, in these places, is from the middle of January or the beginning of February to the middle of March, and occupies about 40,000 men each year. During these months the herring, as is well known, come near the coast to deposit their spawn in the shallow waters and under the protection of the rocks.

The first indications of the arrival of the herring are seen shortly before their appearance. Innumerable numbers of fish are noticed coming from the high sea and approaching the shore; according to the popular language, a mountain of herring arrive, and is followed by cetaceans and myriads of birds. Inspectors belonging to the fisheries then send by telegraph, to all the telegraphic stations interested, regular information, which is published, so as to keep the fishermen constantly advised of the arrival of the fish: some extra telegraphic stations are, moreover, held ready to be installed at any point on the coast. From the moment the herring pass the entrance of the Gulf, the telegraph indicates their slightest movements, which are attentively observed on the two coasts. Warned by the telegraph, the fishermen soon hasten from all directions with their nets, boats, casks and salt; the purchasers and the traffickers accompany them, and all take the road to where the fishing is likely to be most fruitful. The people on the coast know very well how to appreciate the important rôle which the telegraph plays in their industry, and in the frequent cases when the capture of fish has only been possible by the intervention of the telegraph, the name of "haering du telegraph" is given to the captured fish.

Up to 1870, the telegraphic stations established for the "Vaar-haering" fish were by far the most important; but those which have been constructed since that period for the cod and fat herring (summer and autumn herring) have taken the first place, and now surpass the former as much in regard to extent as to importance. The cod and fat herring fishing is carried on in all the fishing grounds along the coast, from Aalesund to Christiansund, near the Loffoden islands, and on the coasts of the two sides of North Cape, as far as the Russian frontier. It also employs about 40,000 men. This fishery would evidently not be such a source of wealth to the thinly scattered population, if it were not for the telegraph which continually apprises them of the approach of the shoals of fish. The importance of the telegraph is felt especially in autumn, when the fat herring enter the fiords in large numbers.

Apart from the information given concerning the movements of the shoals of fish, the progress of the fishing, the price of the fish, etc., are also sent by telegraph to the different fisheries, and to the cities interested. Furthermore, then telegraph forwards, each day during the fishing season, meteorological bulletins, information concerning the direction and force of the wind, the state of the sea, the temperature, the probability of storms, etc., which is of inestimable value to the residents on the sea shore.

The telegraph is in use three or four months of the year for cod fishing. There are nine telegraphic stations called *de poisson*, and four movable stations, which are transferred from Loffoden to Finmark, for this fishing alone. Besides these, six or nine telegraphic fish stations, and one or two extra stations in the districts of Bergen and Stavanger, remain in active service two or three months in each year, for the Waar-Haering fishery, in addition to which, more than twenty stations are in use during the whole year for the cod and large and fat herring fisheries.

If the principal telegraphic line connecting Drontheim to the northern cities is not taken into consideration, it is found that a capital of about two millions of crowns has been expended for the telegraphic stations, called *de pichenis*, in the fishing districts. The relative importance of this sum can be estimated by noticing that the capital which has been used for the establishment of all the telegraphic stations in Norway, does not exceed 5,300,000 crowns. The expenses of the telegraph for fisheries represent, then, more than a third of the capital of all the lines. It is unnecessary to say that the receipts of the fishing stations, in consequence of the situation of the fishing places, where often few families reside long, are far from covering the expenses which the working of the lines involves. The cost of establishing and keeping these lines in repair also draws heavily on the revenues of the administration of telegraphs in Norway. However, the assistance which these stations render is so important, the capital invested in the fisheries so considerable, and the benefit afforded to the inhabitants so great, that the government finds it to its advantage to aid, as much as possible, the development of this service along the Norwegian coasts.

THE SYNTHETIC PHILOSOPHY.

THE DOCTRINE OF THE UNKNOWABLE.

READ BEFORE THE KANSAS CITY ACADEMY OF SCIENCE, SEPTEMBER 28th, 1880.

BY W. H. MILLER, KANSAS CITY, MO.

In a previous paper, we examined the "Synthetic Philosophy," of Mr. Herbert Spencer, in its aspects as philosophy, and found fault with it, for its failure to make any attempt to explain the ultimate form of being, which it holds to be unknowable; for its absurdity in explaining the known into the unknowable; for its failure to supply certain inductions, which we found to follow necessarily from its premises, and which would have explained its unknowable as a personal God; and for setting up force as the ultimate form of being, which we found to be but that property of being by which it expresses itself in action. We also included certain deductions, which, like our inductions, show that this ultimate being is a personal God; but, as the philosophy holds that all such deductions are illegitimate, we propose here to put them to the test of examination, and determine if this is the case. These deductions are denied, not only by this philosophy, but by all who adopt it, and by all who accept the modern hypothesis of evolution; for both forbid us to assign any attributes, aspects or qualities whatever to ultimate being, upon the basis of which alone it can be held to be unknowable. Whether these deductions are legitimate or not, may be shown by a brief reference to the necessary conditions of thought. This involves an inquiry concerning these conditions, and the limits and nature of human conceptions in the direction of the Infinite and Absolute. We cannot take a better point from which to project this inquiry than the deliverances of this philosophy, and its quotations from others upon which it relies for support.

We find it quoting extensively from Sir William Hamilton and Mr. Mansel, certain of their conclusions on the subject, in which they have given their great names and high authority to grave errors, which underly that mysticism of modern times, which has corrupted philosophy in its sources, given to scientific truth a shadow of uncertainty, and to religion an unbelief that is a fruitful source of immorality.

Sir William Hamilton, in his essay on the "Philosophy of the Unconditioned," holds this language. "The mind can conceive, and consequently can know, only the limited and the conditionally limited. The unconditionally unlimited, or the Infinite, the unconditionally limited, or the Absolute, can not be positively construed to the mind; they can be conceived only by thinking away from, or abstraction of, those very conditions under which thought itself is realized. Consequently the notion of the unconditioned is only negative—negative of the conceivable itself." To the doctrine that the mind can conceive of no more than "the limited and the conditionally limited" all must subscribe; but the doctrine that the mind can attain to a conception of any kind whatever, by "thinking away from, or abstraction of those very conditions under which thought itself is realized," represent the mind as transcending its conditions, and is absurd. And that it can entertain a notion that is "negative of the conceivable itself" is equally so, for it represents the mind as conceiving an inconceivable nothing. Again he says: "As the conditionally limited (which we may briefly call the conditioned), is thus the only possible object of knowledge and of positive thought—thought necessarily supposes conditions. To think is to condition; and conditional limitation is the fundamental law of the possibility of thought. For as the greyhound cannot outstrip his shadow, nor (by a more appropriate simile) the eagle outsoar the atmosphere in which he floats, and by which alone he is supported; so the mind cannot transcend that sphere of limitations, within and through which exclusively the possibility of thought is realized." To this likewise, all must subscribe, but, this being true, how can the mind, by "thinking away from, or abstraction of, those very conditions under which thought itself is realized," attained to a notion that is the "negative of the conceivable itself?" It is wonderful that so great a mind as that of Sir William Hamilton could have fallen into so grave and palpable a contradiction. But, to quote further, he says: "The conditioned is the mean between two extremes, two inconditionates, exclusive of each other, neither of which can be conceived as possible, but of which, on the principles of contradiction and excluded middle, one must be admitted as necessary." Can any thing be more wonderful than that so great a logician should thus apply a law of logic to prove that which this same law condemns as impossible? Can anything be more absurd than to hold that the law of the mind requires it to admit as necessary truth that of which it cannot possibly conceive, and which is contradicted by its conception? Sir William Hamilton himself seems to have had a suspicion of this, for he declares that "by a wonderful revelation we are thus, in the very consciousness of our inability to conceive ought above the relative and finite, inspired with the belief in the existence of something unconditioned beyond the sphere of all comprehensible reality," which simply means that Sir William Hamilton, after having made a mistake in his application of the law of thought, whereby he had proved that infinite and absolute Being could not be, still could not rid himself, as others claimed to have done, of the conviction that there is such Being.

The quotations from Mr. Mansel are from his "Limitations of Religious Thought," and we copy: "The very conception of consciousness, in whatever mode it may be manifested, necessarily implies distinction between one object and another. To be conscious, we must be conscious of some thing, and some thing can only be known as that which it is by being distinguished from that which it is not. But distinction is necessarily limitation; for, if one object is to be distinguished from another, it must not possess some form which the other has. But it is obvious the infinite cannot be distinguished as such, from the finite by the absence of any quality the finite possesses, for such absence would be a limitation, Nor yet can it be distinguished by the presence of an attribute which the finite has not, for, as no finite part can be a constituent of an infinite whole, this differential characteristic must itself be infinite, and must at the same time have nothing in common with the finite. We are thus thrown back upon our former impossibility; for this second infinite will be distinguished from the first by the absence of qualities which the latter possesses. Consciousness of the Infinite, as such, thus necessarily involves a self-contradiction, for it implies the recognition of a limitation and difference of that which can be given only as unlimited and indifferent." This only proves that Mr. Mansel has wholly mistaken the nature of the conception he is discussing, holding that it must be something different from any thing that can be; and his mistake has led into a self-contradiction, which ought to have been sufficient to have warned him of his error. But to extricate himself he proceeds thus: "This contradiction, which is utterly inexplicable on the supposition that the Infinite is a positive object of human thought, is at once accounted for when it is regarded as the mere negation of thought. If all thought is limitation—if what we conceive is, by the very act of conception, regarded as finite, the Infinite, from a human point of view, is merely a name for the absence of those conditions under which thought is possible." That is to say in plain language, there is no Infinite; it is nothing. Yet Mr. Mansel holds that we are compelled by the conditions of our minds to believe in the existence of the Infinite, as the complement of our consciousness of the finite; whereby he falls into the same absurdity that characterized the reasoning of Sir William Hamilton.

To these proofs of an unknowable, such as they are, which Mr. Spencer approves, he adds one of his own. His says: "Every complete act of consciousness, besides distinction and relation, also implies likeness. Before it can become an idea, or constitute a piece of knowledge, a mental state must not only be known as separate in kind from certain foregoing states to which it is known as related by succession, but it must be known as of the same kind with certain foregoing states." Not to quote unnecessarily, this doctrine is, that ideas, to be ideas, must be classified; and he adds that "a true cognition is possible only through an accompanying recognition"—that is, a recognition of preceding cognitions with which it may be classed. This Mr. Spencer foresees commits him to the absurdity of an unclassable first cognition, which is here held by him to be impossible; in view of which, according to this doctrine, there can be no cognition at all, and thought and knowledge are shown to be impossible. But he endeavors to extricate himself from this predicament by the argument "that cognition proper arises gradually, that during the first stage of incipient intelligence, before the feelings produced by intercourse with the outer world have been put in order, there are no cognitions, strictly so-called; and that, as every infant shows us, these slowly emerge out of the confusion of unfolding consciousness as fast as the experiences are arranged in groups." Here it is sufficient to point out, that as no cognition can be according to this doctrine, until there is a preceding cognition sufficiently definite to class it with, the argument does not extricate him from the absurdity, however gradual the process may be. But the argument concerning the infinite, and the absolute as well, which he bases upon these fallacious premises, is: "The First Cause, the Infinite, the Absolute, to be known at all, must be classed. To be positively thought of, it must be thought of as such or such—as of this or that kind. Can it be like in kind to anything of which we have sensible experience? Obviously not. Between the creating and created there must be a distinction transcending any of the distinctions existing between any of the divisions of the created." This doctrine of the necessity of classification, as a prerequisite to cognition, is one of Mr. Spencer's psychological doctrines, the validity of which will be examined in the proper place in these papers; suffice it to say for the present, that if it be true, we have no conception of Time nor Space, neither of which can be conceived as like any other thing in the universe. But inasmuch as we know certainly that we have conception of Time and Space, the argument does not prove that a conception of the Infinite is any less possible.

In regard to these three doctrines upon this subject, it must be remarked that when we find our reasoning results in self-contradictions, it is not safe to conclude that reason is mendacious until we shall have proved that we have not erred in the application of its laws. Such an occurrence should suggest to us the necessity of proving our process; as the school boy, when his multiplication fails to bring the answer laid down in his text book, proves his process by a division; and as he assumes that the error is in his process, and not in his book, so may we safely assume that the error is in our process and not in the constitution of the mind.

If thus we find the doctrines of these great thinkers to be, upon this subject, contradictory and absurd, we may safely suspect that they have erred in their process, and proceed to look elsewhere for the truth. That which has the appearance of truth, in this particular, lies patent on the face of things, and it seems wonderful that trained and thinking minds should have overlooked it. It may be formulated thus: Whatever exists within the scope of our conceptions, that we can conceive as bounded only by itself, and which is not wholly embraced within our conceptions, must be held to be infinite; and that part of which we can conceive symbolizes to us that of which we cannot. An illustration will make this clear. Space and Time, and Quantity in its abstract sense, have been held by all thinkers and all mankind to be infinite. We can conceive of no Space as bounded without at the same time conceiving that there is other Space beyond the boundary. We can conceive of no Time as bounded, neither past nor future, without at the same time conceiving that there is other Time beyond the boundary. We can conceive of no Quantity so great that it might not be greater and if none so small that it might not be less. Our conceptions cannot entertain any limits to any of these, except it be limits imposed by the same thing lying beyond the limitations; yet our conceptions will not embrace the unlimited. Mr. Spencer gets a faint shadow of this idea, and holds that we, of necessity, construct a mental symbol for the infinite and absolute which stands for it in our conceptions as the correlate of the finite; and he thus presents the best possible criticism upon his own doctrine, above quoted, for such symbol is certainly unclassed and unclassable. But from this idea of a symbol, which is a true idea, he falls into the surprising error of declaring that we should treat such symbolic notion as utterly without resemblance to that for which it stands." Now, as the Space, Time and Quantity which we conceive to lie beyond the uttermost grasp of our conceptions, can be conceived only as being exactly like the Space, Time and Quantity lying within our conceptions, it follows that, if we treat that within as a symbol for that without, we must not only not regard our symbol as utterly unlike that for which it stands, but the conditions of consciousness leave us no choice but to conceive it as exactly like that for which it stands. Thus, as the Space, Time and Quantity within our conceptions stands as a correct and truthful representation of the Infinite Space, Time and Quantity, beyond they show us how our formula makes infinity comprehensible.

In regard to the Absolute, we need not quote so extensively from these great thinkers as we have done in regard to the Infinite; yet we must make a few extracts from their doctrines. Mr. Mansel writes: "A second characteristic of consciousness is that it is only possible in the form of a relation. There must be a subject or person conscious, and an object, or thing of which he is conscious * *. The destruction of either is the destruction of consciousness itself. * * * To be conscious of the Absolute, as such, we must know that an object which is given in relation to our consciousness is identical with one, which exists in its own nature out of all relation to consciousness; but to know this identity, we must be able to compare the two together; and such a comparison is itself a contradiction. We are, in fact, required to compare that of which we are conscious with that of which we are not conscious; the comparison being an act of consciousness, and only possible through the consciousness of both its objects." To escape this contradiction, Mr. Mansel has recourse to the same absurdity into which he fell in discussing the Infinite—that the Absolute is merely the negation of a conception. He writes: "The Absolute is a term expressing no object of thought, but a denial of the relation by which thought is constituted." But this he holds "does not imply that the Absolute cannot exist; but it implies, most certainly, that we cannot conceive it as existing." Yet he holds that "we are compelled, by the constitution of our minds, to believe in the existence of the absolute Being—a belief which appears forced upon us as the complement of our consciousness of the relative and the finite." In this again he represents the mind as under the necessity of believing in the existence of that which his interpretation of its laws shows that it must declare does not exist.

Sir William Hamilton holds a like view, and falls into a like contradictory absurdity, which he expresses thus: "The absolute is conceived merely by a negation of conceivability," which represents the mind, as he did in discussing the Infinite, as acting without the conditions within which alone its action is possible.

Mr. Spencer apprehends an error in Mr. Mansel and Sir William Hamilton in the quotation he makes from them concerning the Absolute, and he seeks to correct it with an explanation of his own, more consistent in character but to the same effect. He holds, in opposition to them, that consciousness of the Absolute is positive and not negative, and that such a conception is constituted, not by any single mental act, but by many. He says: "In each concept there is an element which persists. * * * The persistence of this element, under successive conditions, necessitates a sense of it as distinguished from the conditions, and independent of them." This sense of it he holds to be an indefinite consciousness, "constituted by combining successive concepts deprived of their limits and conditions." Were it possible for us thus to deprive our concepts of their limits and conditions, so as to combine them, it must be observed that, since concepts are constituted of limits and conditions, the process would deprive us of the concepts, and thus render such combination impossible.

This doctrine of an indefinite consciousness upsets another of Mr. Spencer's psychological doctrines, wherein he holds that consciousness is the product of definite mental changes, without which it is impossible. Conflicting as this does with the nature of concepts, and with Mr. Spencer's own doctrine concerning the character of consciousness, it comes close to a great truth, which he approaches still closer in comparing this notion of the conception of the Absolute to the notion of Time and Space beyond the limits of consciousness. He says: "Though not contemplated as definite, it is yet contemplated as real," and "which, though we do not form of its concepts proper, since we do not bring it into bounds, it is yet in our minds the undeveloped material of a conception." But instead of shaping this undeveloped material into a conception, he disappoints us by holding that, while thus "the momentum of thought inevitably carries us beyond conditioned existence to an unconditioned existence," "that ever persists in us as the body of a thought, we give it no shape;" and, in another place, he holds that we cannot shape it into a thought.

Here may be included also the doctrines of Kant on this subject, which seem to have been adopted by Sir William Hamilton and Mr. Mansel, and to the ultimate conclusion of which, of an Unknowable, Mr. Spencer subscribes, while rejecting his argument. He found substantially the same self contradiction in thought when approaching the Absolute that we have seen in Sir William Hamilton and Mr. Mansel, the opposing factors of which he presented as natural antinomies, between which thought expires before reaching a conception concerning the absolute.

That all such self-contradictions must be false, seems self-evident. It is hardly believable that the mind contains within itself the elements of self-destruction; and we ought to find for the Absolute, as for the Infinite, some reasonable explanation. In the first place, it must be observed, as a truth taught by all these dinguished philosophers, that alleged Being, without aspects by which it may be known, cannot be held by the mind to be Being at all; but it is necessarily held to be nonenity. Man has no guide in philosophy save his own reason; from its dicta there is no appeal. Hence, when it is attempted to present to his conception Being without relations, characteristics, aspects, or attributes by which it may be known, the conditions of consciousness leave him no choice; he must declare such attempted representation of Being to be nothing. The doctrines here quoted from the most distinguished thinkers of modern times abundantly illustrate this fact.

Yet that there is Absolute Being, without relations, is recognized by most philosophers and by all of mankind who have projected thought into these altitudes. Its existence is recognized by the four great thinkers whom we have quoted, although their misapplication of the laws of reason and their consequent self-contradictions present a conception of it which the mind must regard as not Being at all but as nonenity. What then can be presented as Absolute Being? If we adopt the old idea of the unity of Nature we shall find that it helps us to a reasonable conception; it presents us all Being as the Absolute, which is also necessarily conceived to be the Infinite. It is being taken as a whole, and hence is not a supreme or chief being, not the active aspect or the passive aspect of Nature, not the energy it manifest nor the substance upon which energy is exerted. It is both; it is all. As such it is infinite and without relations to other being, for there is no other between which and itself there can be a relation even of difference. It is thus necessarily self-existent, and self-regulative. As a whole it is independent, while its parts are dependent upon the whole. It is true that man's conceptive powers will not embrace so stupendous a whole, but he must and always has conceived that there is such a whole. Relations are the characteristics of its parts, and its parts are reliable symbols of the whole, for a part can only be conceived as implying that of which it is a part. Yet, Mr. Mansel writes: "We can have no consciousness of Being in general which is not some being in particular;" which, instead of showing, as he holds, that it "must be one thing out of many," only discloses to us that condition of consciousness which compels us to conceive the Absolute as individual. Thus, instead of being compelled, by a law of the mind, to accept as truth a self-contradiction, as held by Sir William Hamilton; and instead of being under duty "to think of God as personal" and "to believe him infinite," in the face of doctrines which show that we can do neither, as held by Mr. Mansel; we find that the conditions of consciousness leave us no choice but to conceive the Absolute and Infinite as individual. The conclusions of these philosophers show that, though we may blind ourselves with misconception and error, we still cannot escape this necessity. And here we see, without raising any question concerning revelation, that the Infinite and Absolute has so hedged around our minds as to make a failure to perceive it an impossibility. That the only conception of the Absolute that can be formulated is the one here presented is shown, not only by the fact that all others fall into self contradiction and absurdity, but also by the fact that it is a necessary product of our consciousness.

From the conception of absolute and infinite Being here presented, it follows as a necessary conclusion, that the laws we find prevailing around us, are of its production; either as a whole or in some of its aspects, and their constant enforcement are the expression of its potency. As law can be conceived only as the product of intelligence and its enforcement as the expression of Will, this conception demonstrates to us that, so far as Intelligence and Will are concerned, our former deductions are not only legitimate, but are the necessary product of consciousness. As law can be conceived only as expressing the nature from which it proceeds, and as we find laws expressing an emotional nature, we are left no choice but to conceive the Absolute and Infinite as an emotional Being. Intelligence, Will and Emotion, are found only in combination, and only when attended with Consciousness; and as these four constitute Personality we have no choice but to conceive the Infinite and Absolute as Personal.

But how can such a conception as this reconcile the existence of the Absolute and Infinite with the existence of the relative and finite? How can a conception of the existenc of one sole Being be reconciled with the multiplied forms of concrete Being, with which we are so familiar? This brings us face to face with a third great problem of philosophy, which has been discussed since the days of Aristotle, and about which volumes of elaborate error have been written, besides the fallacies of Mr. Spencer on this subject. This problem is no less than the relation of Subject and Object. Here we need not quote from the elaborate former discussions; a statement of what appears to be manifest truth, lying openly on the face of things, will we believe be found to make it so plain and comprehensible as to leave no room for discussion. Upon this subject, it must be observed, that past error has arisen from a misconception of what is embraced under these two terms. The Subjective state has been defined as an active state, and the Objective state has been defined as a passive state. Hence the evolutionists have conceived the activity by which life is manifested to be the result of interaction between dynamic forces external to the living organism and static, or passive forces within; thus reducing man to a mere mechanical automaton, caused, manipulated and mollified by external forces, for the existence of which their philosophy can give no account. Now, the Subjective state is not an *active* state, but it is an *acting* state; the Objective, in relation to its own Subjective, is always passive, is always the recipient of acting power, and hence is always, within itself, in an active changing condition. The Subjective state is one of constancy and unchange; the Objective is one of inconstancy and change. To illustrate:—Man, in his Subjective, acting state, has himself as the object of his activity; he may determine to become something else than what he is—to become more learned, or more refined, or more moral; or he may determine to remove himself bodily from the place he is in to another. From his Subjective state proceeds, along with such determinations, the *acting* by which the result is to be brought about; and this *acting*, in reaching his Objective state, sets up the activity and change by which the determined result is realized. The Subjective aspect of man lies deep in his nature. It is revealed not directly and in itself but indirectly and in what it does. It is the soul: Thought, Will, Emotion, Imagination and Preception are its immediate manifestations and together with the physical body constitute the Objective Aspect. This is man's primary Objective; Nature as Objective to him being so secondarily.

Now to apply this doctrine and illustration to the infinite and absolute Being who we have seen is necessarily the sole Being in the universe. In its aspect as a stupendous whole, it presents the Subjective state, for, manifestly, a sole being that fills all space cannot be conceived as a changeable aggregate, nor as Objective to aught save itself, in respect to being made to act. It can be conceived only as eternally constant, eternally unchanged by any other. But in its aspect as Objective to itself, the *acting* proceeding from its Subjective aspect, produces a state of activity and continual change within itself. Hence arises the concrete, changing forms with which our observation and science make us so familiar. This Subjective, constant, acting aspect we call God; and this Objective, inconstant, active changing state we call Nature. The

—"poor Indian, whose untutored mind,
Sees God in the cloud and hears him in the wind."

has a great truth, which to formulate and explain, would make a modern philosopher immortal.

Thus we find that this conception of the Infinite and Absolute yields us, on the one hand, a conception of an acting constant immutable principle, which is the source of all the activity we see around us and which we call God. The activity we see reveals to us the laws by which it proceeds, which are the expressions of the attributes of the acting principle. The attributes thus revealed to us we find to be immutable; and they also symbolize to us the principle to which they belong, which is thus made knowable and known to the extent that we know them. On the other hand, it gives us a conception of a dependent active and changing form which we call Nature, and which is but the expression of the independent acting principle. It thus validates to reason the doctrine of a personal spiritual God, and it teaches the eternity of nature. Does not this make the Infinite and Absolute knowable to us, as well as the limited and relationals

If we may entertain such a conception of the Infinite and Absolute, as it seems that we must, it dissipates all the sensation and ideal philosophies of the present and the past. It corrects the errors of the erring, some of whom have endeavored to teach mankind that there is no God, and some of whom have endeavored to teach that there is no Nature. We find also that it purges philosophy of its contradictions; and it relieves science of its shadows of uncertainty, for it shows it to rest upon an immutable foundation; and that the phenomena which constitutes its data is the expression of Immutability and not the product of insensate and varying forces, whose existence is unaccountable. The immutable laws underlying the phenomena with which science is concerned reveals to us the immutable attributes of God upon which they are founded. These attributes, like the Principal to whom they belong, are infinite and apply everywhere alike throughout the sphere of their applicability. In this paper we are concerned with but three.

The first of these is that by which effects in the Physical World, and Consequences in the Moral, are exactly proportioned to Causes. In the Moral World we call it Justice. In the domain of physical law, as we well know, effect inevitably follows cause. Here the only escape from the effects of violation is in invoking the action of some law other than the one violated. So in the domain of moral law; for here, as in the physical, we have but to invoke a law other than the one violated, to escape the consequence of violation. This may be done with ease, almost without knowledge, and by each person for itself; by the most lowly and ignorant equally with the most lofty and learned. In the moral, as in the physical, the violation of law brings pain, which suggests the need of remedy; and the experience of mankind shows that, in the moral, we have but to grieve for our offense, turn from the offending course, and resolve upon obedience to the law of our own natures, and the pain disappears and peace and strength come into the soul. This remedy requires no aid from man, and no elaborate knowledge; whereas, in the domain of the physical, the remedy usually requires the intervention of another, and often demands great knowledge. This brings to our view an Attribute which, while not in conflict but perfectly consistent with Justice can be interpreted only as an expression of Mercy for weak and erring sentient beings. Obedience brings, as its reward, the highest beatitude of which man can conceive, while disobedience brings his intensest pain. The existence of such wise and adequate provision for man's moral welfare can not be conceived as springing from one who cares not for him. On the contrary, it reveals to us a Love for us of no mean degree, existing prior to our being. These attributes, like the Principal to whom they belong, must be conceived as positive and immutable; and on our part, they call for obedience to law, which is righteousness; and for a responsive love and gratitude toward Him from whom we receive such blessings, which is positive worship; and for a reflection of like attributes toward our fellows, which is positive virtue and humanity. And though the obedience to law may seem to require self-denial and pain, it is not really so; for the state of feeling from which obedience proceeds, raises the soul above the sense of such things, as all know who have obeyed in spirit as well as in name. Nay more, it mitigates the keener sense of physical pain, as is now explained by science and as is shown by the history of martyrs and the Cross. This is the essence of the highest Religion, which this conception of the Absolute and Infinite relieves of that unbelief which has corrupted our morals and degraded our social relations. Religion is thus shown to be, not a matter of faith alone; not validated to us by the dicta of the church alone, and not alone by the Divine Founder of the church; but as a matter of positive knowledge, validated by our own reason, which shows it to be a necessary product of consciousness, founded upon the infinite and immutable attributes of an Infinite, Immutable and Eternal God.

MEDICINE AND HYGIENE.

GOOD EYES AND FREE SCHOOLS.

BY JOHN FEE, M. D.

The idea, that the existence of free schools, in a country, is the evidence of a perfect civilization, has become so deeply rooted, that he who would contradict it, would subject himself to public reproach. Cheerfully accepting this public sentiment as a self-evident proposition, let us ask: is the highest state of civilization inimical to the physical or bodily welfare of mankind? In reply, we say yes, in one respect only, namely, in its effects on vision. Otherwise civilization is a perfect boon. The most highly civilized communities furnish the best specimens of beauty, of symmetry, and of strength and endurance.

Civilized man has a power of adaptation unknown to the savage and barbarian. He can endure the heat of the torrid zone as well as the African negro, and the extreme cold of the pole equal to the Esquimaux. It is a fact, however, that our public school system, while it is the corner stone of our republican institutions, is inflicting, as conducted, a great injury on the vision of the rising generation and laying the foundation of a mental and physical misfortune to future generations. What the extent is of this deformity, can only be calculated by the value of the eyes as avenues of the soul.

If total blindness is an indescribable calamity to the few, how much of a national calamity is that which narrows its field of vision down to a few inches, and shuts out forever the beauties of landscape and sky? The infliction of such wholesale misery is the mission of a higher education, as at present acquired, and the public school room is the popular instrument of its successful production. We are very particular to assert, however, that the successful pursuit of this higher scholarship does not, necessarily, require the sacrifice of perfect vision, or the enfeebling of that instrument of the mind that affords the most pleasure and instruction.

To state our accusation plainly, we assert that the eyes of school children are undergoing a change of form whereby they are impaired as optical instruments, and that this deformity will, in time, become a regular and constant factor, fixed by the laws of heredity, so that what is now known as a deformed eye will be the normal eye. Let us illustrate: The normal eye is spherical in form, its axis or antero posterior diameter is about one inch in length, and its width, generally, one-twelfth of an inch shorter than its length or axis. Its lens system, or cornea and crystalline lens, have such a focal distance that when the eye is fixed on an object more than twenty feet distant an image should be formed at the center of the eye, on the retina, without any effort at accommodation. When this is the case the axis of the eye and the lens system are said to correspond and the eye is normal. Our present system of school instruction destroys this perfection of the eye, so that when a child has gone through the grammar school, and is ready for the high school, there is in many individuals, such a lengthening of the axis of the eye that no object can be brought to a focus, unless it is brought up close to the face of the observer, and the person is said to be near sighted or myopic. We find then, that, although, the pupil entered the school room with a spherical eye, during a few years of school life the eye has undergone a change, in which its length has been disproportionately increased and the eye has bulged backward, so that its focus is in front of the retina. This change has, obviously, been caused by continuous convergence of the eyes in the effort to bring to a focus rays of light from small print. This surrender of visual health for education is not made exclusively by the children of this country; it is a tribute paid in all countries, where a higher mental development has been demanded. We get as proof from foreign lands the following figures: Vienna—near-sightedness, from 33 per cent. in the lowest grades of the school room to 60 per cent. in the highest. Breslau—myopes in the city schools—first grade 6.7 per cent.; second grade 10.5 per cent. In the normal schools 19.7 per cent.; in the gymnasia 26.2 per cent. At Königsburg the percentage of myopia is 11.1 in the lowest grade, and the enormous amount of 62.10 per cent. in the highest. In St. Petersburg 13.6 per cent. in the lowest grade and 43.3 per cent. in the highest. At Lucerne the rise of near-sightedness in pupils from seven to twenty-one years is from 0 to 61.5 per cent.

For statistics of foreign schools I copy from Dr. E. G. Loring's pamphlet, "Is the Human Eye Changing its Form under the Influence of Modern Education," New York, 1878.

Let us now turn to the researches in schools of the United States. Cincinnati, 630 students examined: District schools, near-sighted 10 per cent.; intermediate, 14 per cent.; normal and high, 16 per cent. Brooklyn Polytechnic, 300 students: Academic department, 10 per cent.; collegiate, 28 per cent. Buffalo Public Schools, 1,003 pupils: The percentage of near-sightedness increased from 5 per cent. at seven years of age, to 26 per cent. at eighteen years. It was further ascertained that one of every four graduates of the Buffalo high school was near-sighted. In New York a careful and exact examination of 2,265 pupils by Drs. Derby and Loring showed the existence of near-sightedness of 3.5 per cent. in children from six to seven years of age, with an increase of 26.78 per cent. in students from twenty to twenty-one years of age, an increase of over seven-fold. At Dayton an examination of 765 pupils gave the following results: Myopia in the district schools, 15.35 per cent.; in the intermediate, 17.65 per cent.; in the high schools, 18.32 per cent.

For statistics of schools of this country, I am indebted to Dr. W. J. Conklin's pamphlet entitled, "The Influence of School Life upon the Eye-Sight with Special Reference to the Public Schools of Dayton."

From the above statistical facts we learn that we are following fast the example of the "effete cities of the old world"(?) in our success in impairing the visual apparatus of our children, and we only lack time and more constancy of habit on on the part of our people, so that the laws of heredity may implant this visual deformity, permanently, into the race. Let us now inquire where there is a remedy for this forboding evil. Most writers on this subject have attributed this loss of vision to the following causes: Defective illumination of school buildings; uncomfortable and faultily constructed seats; insufficient nourishment and the vitiated atmosphere of the school room; too many studies and continuous attention to books. I am free to confess that these faults are auxiliary causes of near-sightedness; but they do not form the ground work of the malady. In this country, the buildings are generally well lighted, and the seats of the school room have been manufactured with due regard to the comfort and health of the pupils. Nor can we admit that the children are not sufficiently fed. As to the number of studies, these, generally, come at an age when near-sightedness could not be easily produced, when it either already exists to a considerable extent, or will not be developed, but can be intensified, if existing. We believe the cause of myopia to be the convergence and accommodation of the eye for small print. It is true that the eye of a child is a perfect optical instrument and has the greatest functional activity, but this very perfectness is a something that ought to be held in reserve. The constant strain on the eye for convergence compresses its coats, impairs its nutrition, weakens the resistance of the sclerotic until its sphericity is changed, and gives place to an elongated axis and myopia. The remedy, then, is in abandoning the primer and books for the first grades of the school room. Instead of these, use books printed on whole sheets of paper, in type as large as those used for posters. These books could contain the alphabet and spelling lessons of two to four syllables, also the elementary lessons of arithmetic and geography, and should be hung up against the wall of the school room, and owned by the city and township organizations. The letters would be so large that they could be seen at any distance within the school room, and would be considered at an infinite distance, so that the pencils of light from them would be practically parallel, and would require neither accommodation or convergence in order to bring them to a focus.

Such an arrangement would enable the pupils to get their lessons and recite them without leaving their seats and without straining their eyes. The rule no convergence and no accommodation for the eye, for the first and second grades, should be absolute. For the subsequent grades there should be a like improvement in the typography of the text books.

The letters should be large so as to be brought easily to a focus and to make large images on the retina. The same object should be secured in the text books of the high school, and the largest text now used should take the place of notes and explanations, and correspondingly larger letters should be used for the general text. I am firmly convinced that these suggestions contain the corrective for the increasing deformity of near-sightedness. Every year brings a higher standard of scholarship into our public schools, and demands increased application and time to text books, so that with the menace of impaired vision comes the responsibility of so controlling the youthful studies, that with the patrimony of a well stored intellect, there shall not come a groping darkness as the penalty of nature's violated law.

SCIENTIFIC MISCELLANY.

RAMBLES OF A NATURALIST AROUND KANSAS CITY.

No. 2.

BY WM. H. R. LYKINS.

Out across the great bridge spanning the Missouri—out into the cool and quiet shadows resting on the clean yellow sands—is a pleasant change from the thronged and dusty streets of the busy city. The south wind murmurs pleasantly through the tall tree tops, and the air is fragrant with the perfume, not of flowers—but of a fungus. A small white mushroom, growing upon dead trees, evolves from the decaying timber a pleasant odor something like that of a ripe May apple (*podophyllum*). Persons wandering through the woods often meet with the scent of this vegetable, but are not aware of the source from whence it comes, thinking that it is the perfume of some wild flower. This large and curious race of vegetation (the fungi) has met with but little attention from naturalists in this country. A contemptuous kick, and the epithet of "toadstool" is generally the best treatment they receive. Yet, in these lowly forms are many of rare beauty of color and delicacy of organization, many valuable for their medicinal qualities, and many prized by epicures as an esculent. The difficulty of keeping them after being gathered, and the poisonous qualities of some, are the principal causes of this neglect. But while some are pleasant to the eye and taste, others are of a directly opposite nature. In an old meadow in this vicinity we once met with a fine specimen of the *Phalloidei*—well named *impudicus*, a curious freak of nature which once seen or *smelt* can never be forgotton. It is of round, obelisk form, about eight inches in height, and from a hole in the top exudes a greenish fluid which has the smell of putrid flesh, scenting the air with its disgusting odor for many rods in its vicinity. Fortunately they are not plentiful, or they would be an unmitigated nuisance. The Cottonwood (*Populus Canadensis*) is par excellence the pioneer of vegetation. Its light cottony seeds are borne far and wide by the winds, and wherever they can find a lodgment they take root and flourish. Let but a tiny strip of sand bar show its surface above the water and it is preëmpted by the Cottonwood and its humble companion the willow (*salix longifolia*). Their foliage arrests the wind-drifted sands, the ground rises around them, and soon another island is wrested from the river. Far out on the plains in lonely ravines and on barren hillsides this tree may be found bravely battling with the elements of wind, fire and lightning, and though often scarred and broken, it generally manages to hold its ground. Then the birds come and rest in its branches, bringing other seeds, and soon a little grove springs up around it, overshadowing a pool of water—a veritable oasis in the desert. Although its timber is not as lasting and useful as the pine, it is an excellent substitute on the prairies of the West. It is of quick growth, attains a large size and may be planted aud utilized while more lasting timber of slower growth is coming on. The young shoots and buds are excellent food for cattle and horses, and the Indians often save their ponies in hard winters by driving them into cottonwood bottoms and felling the young trees for them to feed upon. But the insatiable demands of civilization are fast using up the noble cottonwood forests of our river bottoms, denuding the banks of their protecting care and leaving them a prey to the ravages of the current.

Crossing the bottom, scarred and seared with the traces of the great flood of 1844, when the Missouri resumed its ancient bed and ran from bluff to bluff, twenty feet deep on these low lands, we come to the hills on the northern side. At the extreme foot of these hills the collector will find a layer of shale from which many good specimens of fossil ferns of various species can be obtained.

The shale is rather soft and must be carefully dried in the shade, then painted with some light transparent varnish to save the specimens in good condition. A great variety of trees clothe these hillsides—oaks, hickory, walnut, ash, hackberry, linn, maple and many others of smaller growth; and if you would see a living chromo, painted in all the gorgeous and unerring tints of nature, come here when the first frosts of autumn have colored their foliage with crimson and gold, blue, brown and purple, and you will see one of rare beauty and excellence.

As one stands upon the top of these bluffs and looks down upon the great valley below, with the great river winding through it like a silver thread, he is lost in the contemplation of the vast time it must have taken to carve out this great water course, hundreds of feet deep, through masses of rock, shale and clay. But to the observer of Nature's methods the process is plain and simple. Stand here when the last snows of winter are melting off under the influence of a hot afternoon sun and you will find every atom of this hillside in motion. Thousands of tiny streams and rivulets loaded with sediment are hurrying downward, great cliffs are undermined and plunge down the slope, carrying with them tons of loose rock and earth. By this process and the thawing out of the frost the surface is left in a soft and spongy condition; then comes a sudden thunder shower with its torrents of water, sweeping all this loose material into the river to be scattered along on a thousand sand bars; to be triturated and ground up by the swift current, and finally swept out into the great ocean to build up new co tinents and new worlds. And when you remember that this work has been going on for ages and ages, as constant as the rising and setting of the sun, you can easily imagine how these great valleys have been scooped out and widened in the process of time.

We stand now in the angle of what is called the great bend of the Missouri. This noble river heading far up in the mountains in the northwest, after a southeasterly course of nearly two thousand miles, here makes a sudden turn to the east. On either hand of us is the valley of the Missouri, with its bold headlands stretching far away in the distance, in front to the south, is the broad valley of the Kansas. It is a place to attract the lover of the sublime and beautiful in Nature. But others have been here long ages before us. Around us in the shadow of these great trees are the mounds of the dead—"traces of lost and forgotten races." These mounds are generally placed in groups of three. Some are mere heaps of earth over a few calcined human bones, while others have within them a square, walled chamber with an opening to the South in which the bodies were laid in regular order. One large mound, which the writer assisted in opening, contained only a single skeleton which had apparently been placed in a sitting position. It was that of a huge-limbed, low-browed savage, probably such an one as Gen. Mitchell describes in his "Three Expeditions in the Interior of Australia." He says: "As I was reconnoitering the ground for a camp, I observed a native on the opposite bank, and without being seen by him, I stood awhile to watch the movements of a savage man 'at home.' His hands were ready to seize, his teeth to eat, any living thing; his step, light and noiseless as that of a shadow, gave no intimation of his approach; his walk suggested the idea of the prowling of a beast of prey. Every little track or impression left on the earth by the lower animals caught his keen eye. The wind blew cold and keenly through the lofty trees on the margin of the river, yet that broad, brawny savage was entirely naked. Had I been unarmed I had much rather have met a lion than this sinewy biped." One chambered mound which we opened was filled with alternating layers of wood charcoal and burned human bones, as though a number of human bodies had been burned at the same time; perhaps the wives and slaves of some mighty chieftain sacrificed at his burial to attend him in the other world. What awful rites of human sacrifice or cannibal feasts have been enacted on these lofty hills, accompanied with the shouts and songs of the savage hosts and the smothered groans and screams of the victims as the blazing fires lit up the dark forests below and gleamed out over the rolling waters, we may never know. Nothing is left to tell who they were, whence they came or how they passed away. These mounds are scattered along the bluffs for miles up and down the river. They are doubtless of great age, perhaps as old as the time when the river was yet cutting a new channel through the great deposit of Loess which once filled this valley. It is a puzzle to account for the fact that in some of these mounds of apparently the same age and construction the burials have been so different; in some the bones being burned, in others, in a natural condition. In none of them have any implements of stone or pottery been found, which is evidence of their great antiquity.

FIRE-RESISTING POWER OF BUILDING MATERIALS.

According to experiments made by Dr. Cutting, State geologist of Vermont, with regard to the resisting power of building stones to fire, no known natural stone used for building purposes can be called fire-proof. Conglomerates and slates yield readily to the action of heat, and granite is injured beyond cheap and easy repair by a heat that would melt lead. Among the best resisting stones are the brown sandstone, used so largely in New York for fronts. Limestones and marbles are even better than these, but a heat of from 900° to 1200° is sufficient to calcine them at last into quicklime. In short, most stone buildings are as much damaged by fire as wooden structures are. Brick is, however, rather improved by heat, until the heat is sufficient to vitrify it. Dr. Cutting recommends brick, with soapstone trimmings, as the most fire-proof materials which can be used in buildings.

WATERPROOF CEMENT.

Dissolve guttapercha in bisulphide of carbon so as to form a syrupy mass. Apply this warm to the two surfaces to be joined, and dry if possible under pressure. Another: Guttapercha, 1 ℔.; india rubber, 4 oz.; shellac, 1 oz.; linseed oil, 1 oz. Melt the materials together. The mass becomes solid on keeping, and must be melted before application.

BOOK NOTICES.

CONTRIBUTIONS TO PALÆONTOLOGY, NOS. 2–8: By C. A. White, M. D.: Extracted from 12th Annual Report of U. S. Geological Surveys of Territories. printed July, 1880. Text 171 pages, plates 42.

This is one among the most valuable contributions to Palæontology yet issued from the Government printing office.

The plates are well executed and from my own observation are faithful copies of the organic remains figured, and embrace 18 plates of Cretaceous, 1 of Tertiary, 11 Laramie, 2 Triassic, 4 Carboniferous, 2 Jurassic, 3 of Sub-carboniferous and 1 of Coal Measure fossils.

As the Carboniferous and Coal Measure fossils interest us most, I will briefly note their descriptions.

Pl. 36, fig. 1, *Productus giganteus*. The figure calls to mind that this well known European fossil, from the mountain limestone of England and Russia, has heretofore been unknown in America. The figured specimen was collected by M. L. Kumlein, of U. S. fish commission, from the valley of McCloud river, Shasta Co., Cal. The transverse diameter of specimen measured five and a half inches across the hinge border. Its associated fossils were typical carboniferous (coal measure) fossils. Prof. White says that it is remarkable that this fossil has only been found on the western border of the continent and not the eastern. We know that most of the central portion and eastern border have been carefully looked over for new fossils and rare ones.

Plates 39 and 40 are of sub-carboniferous fossils, chiefly corals obtained from the top beds of what is known in Missouri geology as the Chouteau limestone, most of them being new and very interesting species. Some are from Iowa, but they are chiefly from Sedalia, Mo. *Michilenia placenta* White, *Michelinia expansa* White, *Chonophyllum Sedalience* White and *Lithostrotion Mycrostytum* White, were obtained from Sedalia and are all new species. Others found in the same rocks at Sedalia, which have also been elsewhere found and here figured, are *Lophophyllum expansum*, *Hadrophyllum glans*, *Zaphreutis Calceola*, *Z. elliptica*.

These fossils were chiefly obtained from a buff or drab shale at the top of the Chouteau limestone and just beneath the Burlington limestone. I have also occasionally found them lying loose on the hills of Pettis, Benton, St. Clair and Cedar counties, and they may also, probably, be found in other counties of South Missouri.

The best locality for finding these corals at Sedalia was an apparently limited area now exhausted. The Zaphreutiform corals can still be obtained there. I had noticed this peculiarly interesting locality at Sedalia five years ago, and at that time obtained some very fine specimens from the quarries. The thick brownish-gray Burlington beds appear in fragmentary strata overlaid in most places by broken chert masses, some worn, as if drifted, but other beds are apparently broken in places, and from them some good fossils can be obtained.

Prof. White speaks of the hitherto frequent occurrence of the *Zaphreutidæ* in the Kinderhook and Burlington and Keokuk groups, and of the hitherto comparative absence of other forms, the *Lithostrotion Mammillare* only having been hitherto found.

Dr. White says "the discovery of four new forms of Actinoid corals is a matter of much interest, and the interest is also increased by the fact that they are all types which are unusual in at least American carboniferous strata." Dr. White says conclusively "that such a group of corals is not without a certain Devonian facies."

The vertical range of these corals is small, indicating the short period of the age during the formation of the reef. It is certainly a well marked horizon.

The following is a list of ten species of corals that have been found at this horizon in Missouri, Iowa and Illinois, as indicated by Prof. White: *Zephreutis calceola* and *Z. acuta* of White and Whitfield, *Z. elliptica* White, *Chonophyllum Sedaliense* White, *Syringapora harveyu* White, *Favosites* (*Michelinia*) *divergens* White, M. *expansa* White, M. *placenta* White, *Lepidopora typa* Winchell, *Lithostrotion Microstylum* White.

Plate 42 is peculiarly interesting to amateur palæontologists of Kansas City, for two very interesting fossils were discovered at Kansas City and are here figured: *Pheurotomaria Broadheadu* White, the largest Pleurotomaria yet described from the coal measures. Smaller specimens of this species have been obtained from Pleasant Hill, Kansas City and from Northwest Missouri, but the typical specimen here figured was obtained from the bluffs of Kansas City. It somewhat resembles P. coxanus M. and W., but is specifically very different. It is a handsome fossil and beautifully ornamented; its full height, eighty-eight millimeters; length of aperture, fifty mm.; breadth of same, forty-nine mm.; full diameter of last volution, including aperture, seventy-five mm.

Another fossil figured here is *Conularia crustrela* White, which has only been found in Missouri in a six-inch stratum at Kansas City; specimens of it can be seen in most cabinets of Kansas City. I have also found it at one locality in Montgomery county, Ill. Prof. White speaks of this fossil also having been obtained by Prof. E. D. Cope, from Taos, New Mexico. It is the only species of *Conularia* at present known from the coal measures of the Mississippi valley, although several species have been obtained from sub-carboniferous rocks.

Another new species of Prof. White is the *Naticopsis Morilifera*, a pretty form from No. 72 of upper coal measures at Pleasant Hill, Mo. I have found it nowhere else.

G. C. BROADHEAD.

THE CARPENTERS' STEEL SQUARE AND ITS USES: By Fred. D. Hodgson. Industrial Publication Company, New York, 1880, pp. 68, 12 mo., 75c.

This little work consists of a description of the square and its uses in obtaining the lengths and bevels of all kinds of rafters, hips, groins, braces, brackets, purlins, collar beams and jack-rafters; also its application in obtaining the bevels and cuts for hoppers, springs, mouldings, octagons, stairs, diminished stiles, etc. It is illustrated by more than fifty wood cuts, of value to a practical workman, while the explanations and directions, being written by the editor of the *Builder & Woodworker*, are plain and clear. Every good carpenter will at once see that it is a valuable work in his line of business.

SCHOOL AND INDUSTRIAL HYGIENE: By D. F. Lincoln, M. D., Philadelphia. Presley Blakiston, 1880, pp. 152, 12 mo., 50c.

This is the twelfth of the American Health Primers, which have proved so popular and useful during the past year, and it will be found no less valuable to families and teachers than its predecessors. The author, Dr. Lincoln of Boston, occupies the prominent position of chairman of the Department of Health in the American Social Science Association, and writes from long experience and with a thorough acquaintance with his subject. The subject is treated under two separate heads: *School Hygiene*, in which such topics as food and sleep, bodily growth, amount of study, exercise, care of the eyes, model school room, etc., are fully and practically discussed: and *Industrial Hygiene*, under which head are treated the injurious effects of inhaling dusty and poisonous substances, injuries from atmospheric changes, injuries from over use of certain organs, regulation of hours of labor, duration of life in various occupations, etc. As we have said before, regarding other volumes in this series, the money it takes to buy each one is most usefully expended in any household.

THE THEORY OF SOUND IN ITS RELATION TO MUSIC: By Professor Pietro Blaserna, New York: J. Fitzgerald & Co., 1880, pp. 28, 4 to., 15c.

This is number ten of the Humboldt Library, which still maintains its high standing as a popular science serial. The object of Professor Blaserna, who is one of the Faculty of the Royal University of Rome, is stated to be to expound briefly the fundamental principles of the relation of sound to music, and to point out its most important applications. This is an object worthy of the consideration of the lovers of science as well as the lovers of art, and doubtless both classes will profit by a study of the work. It is abundantly illustrated, and is written in a style both lucid and attractive.

THE NATURALIST ON THE RIVER AMAZONS: By Henry Walter Bates, F. L. S., New York: J. Fitzgerald & Co., 1880, 2 vols. quarto, pp. 80, 30c.

Two numbers of the Humboldt Library complete this whole narrative of an eleven years' residence and travel in South America, which, in the usual shape, would fill a good sized volume and cost $2.00. Here we have a lengthy and entertaining account of adventures, habits of insects, animals, sketches of

Brazilian and Indian life, and aspects of nature under the equator, printed in good style and on fair paper, all for thirty cents.

OTHER PUBLICATIONS RECEIVED.

The Protective System; What it costs the farmer: By Graham McAdam, N. Y. The Valley Naturalist, Oct., 1880; published by H. Skaer, St. Louis monthly, $1.50 per annum. The Specialist and Intelligencer, Oct., 1880: Edited by Chas. W. Dulles, M. D., Phila., Pa., monthly, $1.50 per annum, published by Presley Blakiston. A Translation of three treatises of Plotinus from the original Greek, by Thomas M. Johnson, Osceola, Mo. An examination of the Double-Star Measures of the Bedford Catalogue, by S. W. Burnham. Geological Report upon the Mineral Lands of Major R. H. Melton, by Prof. G. C. Broadhead.

EDITORIAL NOTES.

THE thirteenth annual meeting of the Kansas City Academy of Science will be held at Topeka, Thursday and Friday, November 11th and 12th, 1880. The business meeting will be held at 3 o'clock p. m., of the 11th at the office of Dr. A. H. Thompson, No. 237 Kansas avenue, and the other meetings at the Senate chamber of the State House. The railroad ticket agents at Topeka will sell return tickets at reduced rates to persons in attendance who have paid full fare in coming. The usual reduction in hotel rates is expected. President Fairchild will deliver one of the two popular evening lectures; the other being given by Prof. Lovewell, of Washburn College. The present indications are for a session of unusual interest.

THE Bessemer method of dephosphorizing pig iron, in the opinion of some of the ablest metallurgic experts of the day, bids fair to supersede the laborious and unhealthy process of puddling and to materially cheapen finished iron,

PROF. SWIFT, astronomer of the Warner Observatory, at Rochester, N. Y., discovered another large comet on the evening of October 10th. The fact was noted in the associated press dispatches, but some important and interesting details which could not be telegraphed are herewith given. The new celestial visitor is in the Constellation of Pegasus, right ascension, 21 hours, 30 minutes, declination north 17 degrees, 30 minutes. Its rate of motion is quite slow, being in a northwesterly direction, so that it is approaching the sun. It has a very strong condensation on one side of the center, in addition to a star-like nucleus, which indicates that it is throwing off an extended tail. From the fact of its extraordinary size, we are warranted in presuming that it will be very brilliant, and the additional fact that it is coming almost directly toward the earth, gives good promise that it will be one of the most remarkable comets of the present century. This is the fifth comet which Prof. Swift has discovered, and the increased facilities which Mr. H. H. Warner, the popular and wealthy medicine man, has given him, by erecting a magnificent observatory for his benefit, promise much more for the future. There is a possibility that further developments may prove this to be the great comet of 1812, which is being constantly expected, in which event astronomers will have an unusual opportunity to test the spectroscope for the first time upon these eccentric bodies, and ascertain certainly what they are.

THE Boston *Journal of Commerce* says: "The KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, with its original papers, selections and communications upon various topics, is one of the best filled magazines in its specialty in this country."

WE are indebted to the well known publishing house of Belford, Clarke & Co., of Chicago, for the loan of the cut of the Pueblo village at Taos, New Mexico, shown on page 421 of this number of the REVIEW.

ITEMS FROM THE PERIODICALS.

PATRONS of the REVIEW desiring to subscribe for any of the leading scientific or literary periodicals of this country or Europe can obtain them at reduced prices through this office.

HARPER'S MAGAZINE enters upon its sixty-second volume with the December number. During all those years it has been the most popular periodical of its class, having sometimes reached a circulation of 135,000 copies and never fallen below 100,000. It has grown with the growth of the literature and art of the last thirty years on both sides of the Atlantic; so much so that hereafter it will be published in London as well as in New York. It seems that it has almost reached perfection in the work of its writers, artists and printers, and that it is an indispensable thing to the general reading public.

SUBSCRIBERS of the REVIEW can obtain it through this office at reduced rates.

ONE of the most apropos and practical articles in *Van Nostrand's Magazine* for November is that of Dr. Henry Wurtz, on "Fuel, Gas and the Stong Water Gas System." This magazine continues to be the organ of the engineering fraternity and is deservedly popular with them all.

THE *Literary World*, published in Boston, has almost finished its eleventh volume, and as a critical reviewer of current literature, has no superior in its class. Besides this it is handsome, well printed, carefully edited periodical which is a welcome visitor wherever it is received.

IN the *North American Review* for November we find, in addition to the "Discussion of the Political Situation," by some of the best financiers of the country, the third article, by M. Charnay, upon the "Ruins of Central America; the Nicaragua Route to the Pacific," by Rear Admiral Ammen, and one by Rev. Howard Crosby on the "Coming Revision of the Bible."

THE *Atlantic Monthly* has two articles of scientific character, in addition to the usual interesting table of contents, viz.: "The Silk Industry of the United States," by S. J. Barrows, and "The Future of Weather Foretelling," by Prof. N. S. Shaler.

THE *American Antiquarian* commences its third volume with the October number, the leading article of which is on "Emblematic Mounds, and the Totem system of the Indian Tribes," by the accomplished editor, Dr. S. D. Peet. It is well filled with archæological articles from some of the best writers in the country, and is deserving of the most liberal patronage.

POPULAR SCIENCE MONTHLY presents an unusually full and varied list of articles in its initial number of the eighteenth volume, from the pens of such scientists as Prof. C. A. Young, B. F. De Costa, Dr. Gardner, Professor Alfred B. Mayer, Herbert Spencer, etc., etc.

THE November numbers of *The American Journal of Science and Art* and the *Journal of the Franklin Institute* have not yet been received. They will, with several more of our valued exchanges, be fully noticed next month.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. DECEMBER, 1880. NO. 8.

PROCEEDINGS OF SOCIETIES.

PROCEEDINGS OF THE KANSAS ACADEMY OF SCIENCE: 13th ANNUAL MEETING.

REPORTED BY PROF. J. D. PARKER.

The Kansas Academy convened in Topeka on Thursday, November 11th, and held a business meeting in Dr. Thompson's office at 3 o'clock. There was a good attendance of the scientific men of the State; also quite a number from Missouri. Although the Academy has met with severe loss in the death of Professors Mudge, Fraser, Bardwell and Kedzie, their mantles have fallen upon others, who come forward with alacrity to fill their places. The following officers for the ensuing year were elected: President, J. T. Lovewell of Topeka; first vice-president, Jos. Savage of Lawrence; second vice-president, J. H. Carruth of Lawrence; secretary, E. A. Popenoe of Manhattan, and treasurer, R. J. Brown of Leavenworth.

The collections of the Academy have grown to such an extent that a committee was appointed to secure a separate room for them in the new Capitol building. Fifty dollars were voted from the funds of the society to the Mudge Memorial Fund, and a committee was appointed to superintend the erection of the monument. Mr. Joseph Savage made a report in reference to the fund, indicating that a general interest all over the country has been taken in doing honor to this distinguished geologist. The Academy resolved to take up the geological survey of the State, and appointed a committee to memorialize the legislature on this subject.

The Academy met in the Hall of Representatives in the evening at 7:30 o'clock, and listened to a lecture by President Fairchild, of the Kansas Agricultural College, entitled "Science in Every Day Life," of which we can give at present but a brief abstract. The lecturer did not claim to be a specialist in science. He, however, showed that he was thoroughly familiar with the workings and achievements of science, and took up the various departments of life and showed what great benefits had been conferred upon the world through this means. Science has conferred great benefits upon commerce. The ocean, full of dangers, has become through science the safest and cheapest of thoroughfares. Science has not only warned navigators of danger, but has removed them. Even Hell Gate has not prevailed, the Mississippi has opened her mouths to commerce, and the Alps have been tunneled. Science has made war terrible, and thus reduced its victims. The range of art has increased indefinitely. Men use the results of science without being thoroughly acquainted with theoretical science, and some enjoy the blessings without acknowledgment to those who confer them. All forms of industry have been aided by science, and the lecturer gave many examples, instancing the farmer, manufacturer, etc. In farming, men were getting out of the mere rut of imitation, and by applying science were now on the highway of progress. In our homes, science is testing the food we eat, the water we drink, and the air we breathe. Science finds "death in the pot," where men least expect it. Science discovers poisons in various directions and warns men of the danger. Science has done much in the way of giving us the necessaries of life and has bestowed upon us many of our luxuries. The day of mere muscle among the nations has passed, and the day of mind has dawned. The powers of men are developed and enlarged, and they have acquired skill. All labor becomes ennobled as it uses mind and involves thought. The American watchmaker excels the Swiss watchmaker, not in greater skill, but in superior knowledge of general principles.

Our morals touch, also, on the principles of physical science, and moral teachers must understand these. Wisdom does not consist simply in knowing facts, but in knowing the bearing relations of facts. Men must learn to receive sensations without bias, and interpret them aright. A true interpretation of the principles of nature is the basis of wise living.

But science reaches beyond mere physical forces and touches the infinite, and true science leads us to know and honor the Cause of all things. Science exalts many lines of drudgery into callings that are noble and useful. The progress of the world is in the line of its wants. The growth of invention has followed the growth of our wants. The sounds of the telephone were first heard from a bath tub. From the time that Adam and Eve learned that they needed clothing scientific skill has been supplying our wants.

An accurate science is the greatest stimulus to real progress. The cultivated races meet their own wants the best, and supply something for other races. The man or race whose wants increase more and more every year are on the highway to immortality. The masses of mankind reap the benefits of science in spite of themselves. The lecturer believed that most of the strictly scientific truths would always find their way through the world by experience and life as one jostles against another. Science maintained at the expense of the world returns a hundred fold.

The whole lecture was replete with facts which no synopsis can reproduce, and was received with great interest by the audience.

At 9 o'clock, Friday, the Academy convened in the Senate chamber and the following papers were read : The Judith River Group, by Charles Sternberg. This was an original and valuable paper. Tornadoes, by John D. Parker. The Irving Tornado swept over a large extent of country, displaying seven or eight funnels along its course. The author preferred to make the term tornado comprehensive enough to embrace the whole storm, including all the funnels, instead of making several tornadoes. The paper advocated the thermal theory. Artificial Propagation of Food Fishes, by D. B. Long. The author of this paper spoke of the processes for the artificial propagation of fishes, and gave a list of those food fishes which are best adapted to Kansas. The preliminary List of the Reptiles of Kansas, by Frank W. Cragin. This was the first contribution to this department of science in Kansas and showed original work. Traces of the Aborigines in Riley county, by Prof. G. H. Failyer. Archæology has become one of the most interesting of all branches of natural science, and the author of this paper has collected considerable material which was of absorbing interest to the members of the Academy. The paper was characterized by the presentation of facts more than theories. The Burlington Gravel Beds, by Robert Gillham. Since the discovery of the Burlington gravel beds, ten years ago, they have become pretty well known. The beds are probably the result of modified drift. No better material for macadamizing streets can be found than this beautiful chert, which possesses all the characteristics for such purposes. Mr. Gillham is a practical engineer in Kansas City, and he went down to Burlington professionally to examine the beds. His report is as favorable as could be desired, and this gravel will now probably come into more general use as a macadam. The morning session was well attended and of unusual interest. The papers were thoroughly discussed by the members, and the Academy is evidently increasing in members and power. The Academy is doing a large amount of original work from year to year, and the results have already become known throughout the scientific world.

At the afternoon session a large number of commissioners were appointed for the coming year, covering the whole field of science.

Dr. John Fee, of Kansas City, then read an important paper on Color-blindness, based on original observation. The paper discussed the various theories of color-blindness and found them unsatisfactory. The most probable cause of color-blindness is a congenital defect. The paper then considered the relation of this subject to railroad accidents. Railroad employees sometimes cannot distinguish colors in lights used for signals, hence railroad accidents. Dr. Fee illustrated his paper by worsteds, used for Holmgren's tests of the various colors, and held that railroads should examine their employees in regard to this matter. He hoped Kansas would, by legislative action, cause such examinations to be made, and thus follow the example of some of the eastern States.

Professor Snow then read a paper giving "Additions to the Catalogue of Kansas Lepidoptera." One hundred species have been determined during the year.

Professor Parker read a memorial paper of Professor Mudge, giving a brief narrative of his life and labors. Professor Mudge was the first president of the Kansas Academy of Science, and was president when he died. During all the twelve years he was connected with the Academy, he was indefatigable in his labors for its success. His papers are all based on original observation and experiment, and are most valuable contributions to science. He discovered the *ichthyornis dispar*, or the bird having teeth, which is now kept for safety in a fire proof safe, being the only specimen ever discovered. He discovered the so-called bird tracks in the Osage valley, which would have made a reputation for any geologist. On the day of his death he spoke of eighty new species which he had discovered, many of which bear his name, and it is probable he discovered many more, as Professor Mudge was very modest in speaking of his own labors, although he was always prompt in noticing the labors of others.

Professor Mudge possessed personal qualities which made him a valuable friend and neighbor. He was loved by all his pupils and by his neighbors: a sure test of a good man. He died at his home, November 21, 1879, of apoplexy. Scientific men from various portions of the State and from other States were present at his funeral to aid in doing honor to him who had done so much for the New West. Although Professor Mudge never claimed the honor of originating the Kansas Academy of Science, and in his report on the organization of the society published in the Transactions of the Academy for 1870, gave this honor to another, yet he was the first and last president of the Academy, and his services to the society were invaluable. As long as science has a votary in the great central plains of the North American continent, Professor Mudge will not be forgotten.

Mr. Joseph Savage then read an interesting paper on Concretionary Forms, which was amply illustrated by specimens from all portions of the State.

Professor Lovewell next read a paper on Weather Observations in Kansas. The Professor has recently inaugurated a system of State meteorological observations, similar to those of Professor Nipher in Missouri, and of Professor Hinrichs in Iowa, and has enlisted in its behalf a large number of observers at various points. He expects shortly to have reports from every county in the State. The object of this paper was to indicate the general scope and purpose of the Kansas Weather Service.

Mr. Eli H. Chandler, of Topeka, discussed in an illustrated paper the Feldspar Groups of Minerals. The paper was a contribution based on original observations. Professor Snow then read a paper on "The Last New Kansas Bird." Since the last meeting only one species has been discovered. This makes 303 species known in Kansas. This bird is the Ibis. In Egypt the sacred Ibis was embalmed and formed in ancient times an object of worship. The specimen was taken near Lawrence by Mr. W. S. Bullene. Professor Snow thinks there may be twenty-five or thirty species of birds in Kansas not yet discovered, and wishes to learn of any new bird that may be found. A preliminary list of reptiles of Kansas was read by F. M. Crozier. The author enumerates eighty-seven species, including twelve species of tortoise, thirteen of lizards, forty-two of harmless snakes, five of salamanders, and five of poisonous snakes. Among the latter the copperhead has been found in a few counties. This paper formed an important contribution to this branch of science.

Judge Adams discussed Irrigation. He said the papers had all been on dry subjects; he would read on a wet one. The paper gave original observations and valuable suggestions. The paper referred more particularly to irrigation in Western Kansas, to Sequoyah county, and counties lying round about. It would pay the State of Kansas to make a careful survey of those portions of the State that need irrigation.

Mr. H. R. Hilton, of Topeka, read a paper on Rainfall in its Relation to Kansas Farming. The paper discussed the different soils of the State and their power of absorbing moisture. When Kansas was first settled it was thought the State could not be cultivated west of Topeka except along the valleys. Now good crops are raised 300 miles west of the east line of the State. Cultivation, planting forests, stopping devastating prairie fires, and a change of grasses, with mulching have been the principal means of these great changes.

A dry stratum of air near the earth prevents precipitation of moisture, and the storms have a tendency to pass over us. Storms have become less violent and more general. The changes going on have tended to establish a connection between the earth and the clouds. We must prevent radiation and increase deposition of moisture. As an evidence that our former dry climate is passing away, the mirage formerly so common, and a result of a dry climate, is now seldom seen. Western Kansas may never have as much rain as Eastern Kansas, but the soil does not require it. In Western Kansas wheat can be surely raised three years out of four. Stock should be raised in Western Kansas, and farmers should learn to plow deep. The author believed that Kansas can, by applied science, be made one of the best agricultural States in the Union.

A very large audience gathered in the senate chamber in the evening and Professor Lovewell gave a lecture on "Science in the Common Schools." The lecturer gave a brief survey of science instruction in the schools he had been connected with for the twenty-five years during which he had been a teacher. Twenty-five years ago, science was subordinated to the classics and other studies. The programme of school studies was left very much to the teacher. Botany was taught by ladies, and boys were not expected to study botany any more than they would embroidery. Pupils were never allowed to see how experiments were prepared. When Agassiz came over there was a great change, as indicated by such schools of science as the Sheffield school, at Yale, and the Chandler school, at Harvard. The lecturer gave some recent personal observations of science teaching in the East. He spoke of science literature. Harpers' science department was read and relished as much as any other department of the magazine. The leading journals now are called upon to furnish scientific literature, edited by men trained in this department. The teaching in our public schools has changed very much in twenty five years and science is gaining ground.

The lecturer then considered how science is taught in our schools. The methods are very much improved, still there is too much of books and too little of nature. There is a lack of originality. The grades have been an obstruction. Public schools have too much of statistics and too little of apparatus. The laboratory of public schools is often a rubbish room. Specimens have been considered as mere curiosities. Teachers need to be trained to scientific methods. The laboratory should be a place of work and investigation. Two things have worked against the study of science. Experiments cost something and science requires hard study. There are many means of scientific illustration in every day life in manufactories. Professors in our schools have often been on the best terms with the superintendents of manufactories, realizing that they often furnish the best illustrations of scientific processes. The lecture concluded with valuable suggestions in reference to the improvement of our schools in teaching science. The votaries, however, in looking over results, can thank God and take courage.

Col. Theo. S. Case was then introduced and delivered his lecture on the ancient city of Pecos, New Mexico. This lecture was recently delivered in Kansas City where, as well as at Topeka, it was well received.

The Academy met in the Senate chamber on Saturday morning, the abundance of material furnished in the programme, overflowing the limit of two days. Mr. B. B. Smyth, of Great Bend, read a paper on The Plants of Central and Southwestern Kansas. The paper was illustrated with a beautiful herbarium of the plants described. The author said he had traced the roots of the *Amorpha canescens* twenty-six feet deep in the ground, where they were uncovered in digging a well. The paper showed original work.

Professor Sadler, of Emporia, was called upon to explain a pinch-cock, with a tangent screw, which he had invented to aid in chemical manipulation. With this ingenious device half a drop can be obtained in a given time, a supply very satisfactory in laboratory processes.

Mr. D. C. Tillotson, of North Topeka, read an interesting paper on "Fragments of Pottery on the Upper Solomon." Some of the pottery was found in a mound partly washed away, and was attributed to the Mound-builders, and some of the pottery to the Indians.

Mr. J. C, Cooper gave, by invitation of the president, a narrative of his observations relative to some Mineral Formations in Colorado. He spoke particularly of the natural processes by which minerals have been deposited; and favored the theory of infiltration, by which minerals have been deposited from solution. Minerals may have also been deposited by vaporous action from below. The processes of mineral deposition were so various that he thought it was safer not to be too positive in our theories.

President Lovewell gave a narrative of a visit to the laboratory of the medical college of Harvard University, and of some new and very interesting experiments with the platysmagraph. This ingenious instrument shows the influence of the mind on the muscles.

A student had said he could translate Latin and Greek with equal facility, but the instrument showed that the translation of Greek affected the muscles the more.

Professor Snow read a paper making valuable additions to our knowledge of the Coleoptera of Kansas.

Prof. G. H. Failyer read a paper, with illustrations, on the Skeleton of an Elephant found near Manhattan.

Mr. Savage read a paper on Some Implements found in Trego county.

Judge Adams read a paper on Science Teaching in common schools. This paper contained many most excellent suggestions. The author claimed that more science should be taught in our public schools.

Professor Carruth read a paper making valuable additions to the plants of Kansas.

Several papers were not read for want of time, but will be printed in the Transactions of the Academy.

The Kansas City Review of Science and Industry was highly complimented by the president and several members of the Academy, and its editor elected an honorary member.

After the transaction of some routine business the Academy adjourned subject to the call of the executive committee.

ST. LOUIS ACADEMY OF SCIENCE.

A meeting of the Academy of Science was held November 15th at Polytechnic Hall, Mr. Albert Todd in the Chair and Professor Nipher acting as secretary.

Professor Nipher made a report on the proposition to change the place of meeting to Washington University, and stated that two large rooms could be secured in the third story of the old Academy building. The cases for the library will cost $175, and the furniture about $25. Owing to the absence of Dr. Engelman, the committee was granted further time to complete arrangements for the removal.

Corresponding Secretary Holmes read several letters, and presented a large number of publications received since the last meeting. He also spoke of

Dawkins' work on the Antiquity of Man, and concurred in the opinion that the race existed in the middle pliocene period.

Professor Nipher explained Bell's method of transmitting light, and showed by a diagram on the blackboard how rays of light may be made the medium of speech through the photophone.

There being no further business, the meeting adjourned until next month.

LEAVENWORTH ACADEMY OF SCIENCE.

The Academy of Science held its first meeting of the season at the Academy hall November 17, and was well attended. The lecture of the evening was by Judge Crozier, on "Chief Justice Marshall." The programme for the remainder of the season is as follows: December 16th, Dr. Tiffin Sinks, "A Visit to Rome illustrated;" January 13th, Dr. W. W. Backus, "An Old Egyptian Theory of Creation;" February 10th, Prof. F. A. Fitzpatrick, "Working of the Signal Service;" March 10th, Prof. W. W. Grant, "Utility the Test of Education;" April 7th, W. S. Burke, "Fossils;" May 5th, Dr. R. J. Brown, "Medicinal Plants of Kansas." There will be a meeting between every two of the above dates, when lectures will be delivered by parties from abroad who have agreed to speak, but were not prepared to give dates.

GEOGRAPHICAL NOTES.

MR. B. LEIGH SMITH'S ARCTIC EXPEDITION.

The following particulars of the voyage of the steam yacht Eira, of Peterhead, belonging to Mr. B. Leigh Smith, of London, to and from the Arctic regions, have been furnished the London *Times*. Mr. Smith, as is well known, has had considerable experience in Arctic navigation, and has done a great deal in the way of helping to clear up the mystery attaching to the unknown quarter of the globe near the North Pole. The Eira is a steam vessel of 350 tons gross, measuring 135 ft. in length by 25 ft. of beam. She sailed from Peterhead on the 19th of June, with a crew of 25, all told, including Mr. Leigh Smith, owner of the yacht; Mr. W. J. A. Grant, photographer; Dr. Neale, physician; and Captain W. Lofley, as ice master. The object of the expedition was to follow up the discoveries already made in the direction of the North Pole, and to obtain as high a latitude as circumstances would permit. After shipping the remainder of the crew at Lerwick, the Eira sailed on the 22d of June, and a week later reached Jan Mayen Island. They found the ice almost encircling the island—a somewhat rare occurrence at that late season of the year, as it is an unusual thing to come up to the floes so far south. They anchored near Egg Island at 4 a. m. in nine fathoms of water. That morning Mr. Grant and others went ashore with the intention of collecting specimens and obtaining photographs of the place, but by noon they saw the ice drifting down and surrounding the ship, and thought it prudent to return on board. The ice continuing to come into the bay, they steamed away to the north-east, but were confronted by the main pack, which caused them to alter the course to a south-easterly direction to avoid being beset by the ice. On the 2d and 3d of July they got among the bladder-nosed seals, and shot over 300 of these animals. They followed the ridge of the main pack among loose ice until July 6th, when they made an attempt to reach the east coast of Greeland, near Cape Bismarck—the farthest point that the Germans reached. Land had been seen about 100 miles north of Cape Bismarck, and Mr. Leigh Smith's intention was to explore northward toward the point marked on the chart. They worked in toward the west until the 9th in 75 40 latitude; but the weather was foggy, and all the time the ice was getting closer and heavier, some of the floes met with being very large. On the 9th nothing could be seen from the crow's nest but ice closely packed, and the idea of going further west had to be given up. It was very discouraging to have to work their way back again; but it had to be done. They reached the open sea again on the 11th. On the evening of that date they sighted two whalers—the Eclipse and the Hope, of Peterhead. The three ships remained in company until the 13th, on the morning of which day the Eira was steered northward through loose ice. On the 16th they came upon block ice in 75 50 north latitude, and about 5 east longitude, and had to go eastward toward Cloven Point—a well-known landmark to the north-west of Spitzbergen. Passing that point they anchored to a floe of land ice off Welcome point on the 18th. The intention at this point was to steer north; but after more battling with the ice they had again to bout ship and make the best of their way to the open sea. It is mentioned as an unusual circumstance that the islands known as the Norways and Fair Haven were closed with ice. They anchored at the head of Smeerenburg Bay and took in water on the 20th; and, having sailed at once, were taken in a strong gale and had to seek shelter in Magdalen Bay. They lay there three days. The gale over, they sailed southward, and cleared the South Cape of Spitzbergen at midnight on the 30th of July, and next day came upon loose floating ice, which as they advanced, got much closer; and about 9 p. m., when within 24 miles of Hope Island, they had to take a southwesterly course to get clear of the ice. They reached a point 76 latitude and 25 longitude, and wanted to work northward after rounding the ice toward Wiches or King Charles Land, but finding this impossible, they took a north-easterly course with the idea of getting to Franz Josef Land. They reached the pack ice on the 6th of August in 77 14 latitude, and the course had again to be changed. Thence they continued in a northeasterly course, leaving the ice to the west, until the 8th, when they reached 79 4 latitude and 45 38 east longitude, and met with ice again. From this point they took a northerly course, and encountered very misty weather. On August 10 they reached 79 40 latitude and about 46 50 east longitude—the farthest point yet reached in this direction. Nothing could be seen but ice in very large and heavy floes, although it was expected that land would have been in sight. They returned in the afternoon with the intention of making for Franz Josef Land, and after getting clear on the 11th were caught in a strong gale and driven south as far as 78 17 latitude and 46 19 east longitude. From this point they steamed right up, and on the 14th, at 8 a. m., they sighted the land. In the afternoon they anchored to a land floe, attached to an island off the mainland—some 1½ miles long. Here they found large numbers of walruses, and that evening the party shot no fewer than 17 of them. They tried hard to capture a young walrus alive, but failed. They caught seven young snow birds with the intention of bringing them home, but only one survived the passage, and it was dispatched to the Zoölogical Gardens along with two live bears on Saturday. Next day they had to shift on account of the drifting of the ice, and in the afternoon anchored to a floe some two miles long at a distance of ten miles from the land. Far "inland" they found an enormous tree with branches and roots apparently complete as it had been torn out of the ground. It is a common thing to find drift wood in these regions, but an entire tree is a rare sight. It is likely that the tree was a Siberian larch, and that it had been washed down by some of the Siberian rivers.

On the 16th they came upon another island, on which they landed, and erected a staff on a cairn, in the center of which they left a record. On these islands a number of curious specimens were found. The last Dutch expedition sighted land westward of this, and called it Barents Hook. This point was also seen by Mr. Smith, and the Eira was steered toward the land. They passed the point close to the land in foggy weather. Early one morning they landed on the island some 20 miles from the easternmost point, and found luxuriant vegetation. While off this island they sounded and found the average depth to be from 15 to 20 fathoms about a mile off the coast. At noon on the 18th they discovered a new harbor, which they had no hesitation in naming Eira Harbor, after their vessel. It is formed by two islands, and affords good anchorage of from five to seven fathoms. It is well sheltered from all sides. It lies in 80 5 25 north latitude, and about 48 50 east longitude. This harbor was made a rendezvous, from which for the next few days, numerous trips were made up the numerous fjords which pierce the main land to the north and northwest. From the point named by the Dutch Barents Hook they traced the land westward some 110 miles, and from the extreme northwest point reached sighted land 40 miles further to northwest. They found that this land was divided from the newly-discovered islands by a sound, which seems to be an extension of Markman's Sound. Lying in this hitherto unexplored tract of sea they discovered seven small islands, each measuring four to five miles long, and four larger islands—these latter being in the vicinity of Eira Harbour—the largest from 18 to 20 miles long, and the smallest from six to seven miles long. They are all covered with glaciers and snowfields, with bluff, black headlands on the southern exposures, whereon was vegetation. A large quantity of Arctic flowers and other specimens was collected and brought home. On one of these islands close to the harbor were hills 1200 feet above the level of the sea, but large tracts of flats were seen stretching from the foot of the hills. On one of these islands they caught the two bears which, as mentioned above, were sent to the Zoölogical Gardens. The final trip from Eira Harbor was made on August 24, and it was on that day that they reached the most northerly point yet attained in that direction—80 20 north latitude, and about 40 east longitude. From that point they could see land to the northwest, some 40 miles off, and it was supposed that this was but a continuance of the same coast line. This they intended to follow up, but they had again to give up the attempt in consequence of the ice driving along the shore and carrying the ship along with it. Mr. Leigh Smith's opinion is that, whether this land extends in a continuous line northwest or forms the outline of separate islands, it forms a very good basis whence to prosecute researches further northward. When they found further progress impossible they returned, and experienced very bad weather. In one of the deep bays which indent the coast they sighted two Greenland whales, in about the same latitude as the furthest north point attained. They made for Eira Harbor again, but found it full of loose ice. Proceeding eastward, they anchored in a small bay to the west of Barents Hook. From that point they steamed south a little to clear a large quantity of ice that had come out of the fjords, and on the 30th of August they found themselves close to Cape Tegetthoff, which had been discovered by the Austrian expedition in 1873. In that expedition their vessel, the Tegetthoff, was abandoned, and the explorers persevered in their mission by means of sledges; but though they succeeded in establishing the existence of the land, they had to return and make for Nova Zembla in a boat. Mr. Smith made a search for any traces of the abandoned vessel, but found nothing except a "can" on Wilczek Island. They found fast ice between Hall Island and Salm Island, and also between the latter island and Lamont Island, so that there was no means of getting out to the east or northeast, and as the ice was coming down they resolved to try to cut across by Spitzbergen to Wiches Land, or, as otherwise called, King Charles Land. In this endeavor their common enemy, the ice, confronted them and compelled them to alter their course. They sailed close to the edge of the ice as far as 75½ north and 46½ east before they could get west. They reached Hope Island on September 10, and again endeavored to work northward up the east coast of Spitzbergen, but on the 11th the weather became very rough, and for three days the ship was tossed about in strong gales. They encountered numerous small icebergs. Seeing that nothing could be done in this direction—a pack of ice being discernible in the distance—they took a westerly course until they sighted the South Cape, and then steamed up Storfjord and anchored on the 17th near Ginevra Bay. From a hill here they could see the sea to the eastward was clear of block ice, although icebergs could be seen floating about. From this point Wiches Land could be distinctly seen. Hinlopen Straits also seemed to be free of ice. On the 20th they anchored at the entrance of Walter Thymen's Straits—where they took in ballast—which were also clear of ice. On the 22d they were off Wales Point, and from there they sailed with a fair wind to Hammerfest, in Norway, which they reached on the 25th of September. From that they steamed through the fjords to Tromsoe, and thence to Bodoe. On the way from Tromsoe the Eira went ashore, while under the charge of a pilot, on a reef at the entrance to Tiel Sound, about 11 o'clock at night and just as they were drawing up to the anchorage. The crew made great efforts to release the vessel, but in vain, until on the 4th, when the Norwegian steamer Nordsjerne, which happened to be passing, towed her off with some difficulty. They left Bodoe on the 7th, and, after touching at Lerwick on the 11th, reached Peterhead on the 12th of October. In the course of the voyage some enormous icebergs were seen, measuring from 10 to 12 miles long, having flat "table lands" on the top rising to the height of about 200 feet. They shot 15 bears and 27 walruses, and saw great quantities of saddle-back seals in the water. No reindeer were seen, but snow-hwite foxes were abundant. Careful observations were taken of the temperature and other meteorological tests. Mr. Grant also took numerous photographs of the places visited, and some very interesting specimens of fishes and animals were dredged up and preserved for inspection by scientists in this country. Efforts were made to capture young walruses, but they were unsuccessful, and on one occasion one of the boats was stove in in the attempt. It is gratifying to have to state that no serious case of illness occurred during the voyage. The Eira is to remain at Peterhead until the opening month of next year, when it is understood Mr. Smith will renew his researches.

THE FRANKLIN SEARCH.

We announced yesterday the return in safety of the latest Arctic expedition. Lieutenant Schwatka, of the United States Navy, and his gallant companions, who reached this week the whaling metropolis of Massachusetts, were commissioned, not to make independent discoveries in the region of the North Pole, but to search for relics of the Erebus and Terror. In the process of tracking the footsteps of earlier explorers they have, however, probably undergone as many hardships and had to face as many new difficulties as if the way had never been pioneered before. Expeditions such as this are games of "follow my leader," in which no peril may be circumvented which has once been encountered, and no easy alternative may be adopted. The common type of Arctic journeys presupposes permanent quarters in ships specially constructed and equipped to reproduce as much as may be the comforts of civilized life and a temperate climate in the frigid North. Dr. Kane and other Arctic voyagers have told how possible it is, when the ship is arranged for the night, to look around the warm cabin and almost forget the surrounding waste of savage desolation. Dangers and difficulties and miseries can never be excluded in this kingdom of darkness and winter. No ship can be so well found as to be secure from them. But in a land expedition, such as Lieutenant Schwatka commanded, while the dangers are as many, the tribulations of daily existence are multiplied a hundredfold. The records of Franklin's land expeditions, sixty-one and fifty-five years ago, and of Back's, eight years later, demonstrate what these are. The American members of the Franklin Search Expedition might repeat those ancient tales of continual conflict with numbing cold and privation with variations of their own. Experiences like theirs of a sledge journey of eleven months it would be difficult to match even in the painful reminiscences of Arctic labors. Always conscious of an enemy on the watch about their path they must at intervals have felt his sword at their very hearts. None who have not braved an Arctic winter can rightly understand the mere meaning of a temperature a hundred degrees below freezing-point. How human frames endured such an ordeal it is hard to imagine. Only the human sense of power to bear what others have borne, and the instinct of an obligation to let no scattered clues of hapless generous endeavor perish unrecorded, could have sustained this little company of dauntless sailors amid the warning evidences of Polar remorselessness.

Confronted with Arctic mysteries men forget the minor distinctions of race and country. They appreciate one another's perplexities; they take up the task at the point at which their forerunner has been compelled to relinquish it; and they award him his full share in the glory of final success. Praise is not grudged to the hand which has passed on the torch, though it could not fire the beacon. There is no stint of tears from the survivors, whatever their nation, for lives sacrificed to the attainment of an end, but left without the prize. Citizens of the United States and Englishmen, Danes and Swedes, North Germans, and Austrians are emulous, not envious of a courageous example which has been set by aliens in blood; they acknowledge the common burden of a duty to bear testimony to victories which those aliens have won, and to the cost they have paid. No page is brighter in the history of human enterprise than that which enumerates the ceaseless efforts of a succession of explorers differing in blood and allegiance to rescue from oblivion the work of Sir John Franklin and his comrades. The veteran Arctic explorers whose letters we publish to-day express a natural regret that the success which Lieutenant Schwatka has won should not have been achieved by their own countrymen. But Englishmen may rejoice that in the long and glorious chronicle of these expeditions their kinsmen from the great American Republic share no unequal space with themselves. The munificence of citizens of the United States went hand in hand with the affection of Lady Franklin and the conscience of the British nation in the resolve to bring succor or to build a tomb. If it was given to M'Clintock to disperse the clouds which enveloped the fate of the vessels and their crews, Kane in the Advance had helped to penetrate the darkness. Lieutenant Schwatka has now resolved the last doubts which could have been felt. He has traced the one untraced ship to its grave beneath the ocean, and cleared the reputation of a harmless people from an undeserved reproach. He has given to the unburied bones of the crews probably the only safeguard against desecration by wandering wild beasts and heedless Esquimaux which that frozen land allowed. He has brought home for reverent sepulture in a kindlier soil the one body which bore transport. Over the rest he has set up monuments to emphasize the undying memory of their sufferings and their exploit. He has gathered tokens by which friends and relatives may identify their dead, and revisit in imagination the spots in which the ashes lie. Lastly, he has carried home with him material evidence to complete the annals of Arctic exploration. Sir Leopold M'Clintock found that the brave men who perished on their terrible retreat before the legions of cold and disease toward Back's River had before they acknowledged defeat done their work. The Franklin Search Expedition adds the concluding link to the chain. There are skilful eyes and shrewd wits in the dockyard whence the Erebus and Terror were commissioned, which will soon, with the proof which Lieutenant Schwatka supplies, put beyond controversy the question of the right of the especial ship of the two to the fame of having first pierced the awful barrier of the North-West.

It has been a point of honor with sailors and science to collect the uttermost vestiges of the fate and acts of Franklin and his companions. The task is at length finished. Lieutenant Schwatka asserts, on grounds which at present no means exist of examining, that the records of the expedition are lost beyond recovery. Captain Parker Snow, on the other hand, is of opinion that the records may yet be found. However this may be, there is no longer any secret when and where the admiral, his officers, and his men sickened, fell down, and died. The sad details are given in another column this morning and will be read with painful interest. What the unfortunate explorers did is known, and how they did it. Perhaps it may be thought that, now the book of Sir John Franklin's romantic tragedy can be closed, the fruitless, ungrateful, sullen Polar seas may be left to their dead and dull repose. Rather, as it seems from our correspondence of to-day, the sense that the obscurity of a long past incident has been dissipated will nerve seamen eager for honor and careers to push the boundaries of Arctic impossibilities yet further forward. They will forget at what a price the North-West passage was completed. They will make the graveyard of the explorers of 1845 their starting and rallying point, as men build their homes on the walls of cemeteries. What is to be gained by making a habit of achieving the North-West or the North-East passage it is held in some quarters profane to question. We aré the less disposed to incur the reproach that we admit the uselessness of resisting an impulse which works as powerfully in Austrian and German and Swedish as in British and American breasts. The praise of courage is not the main inspiring motive. Still less is it the craving for admiration, or the hope of rewards. Men, especially those of Anglo-Saxon and Scandinaivan blood, love to match themselves against the caprices of the elements, and to learn thereby their own capacity to do and to endure. Against such a temperament the arguments of danger and hardship are of no avail. Only when the Polar seas and lands are mapped, and all their pitfalls numbered and banked up, American sailors will cease from importuning native millionaires to dispatch them northward, and English sailors from fretting at Lords of the Admiralty for economizing seaman's lives. Huge as are the ramparts to be assaulted, and obstinate as are Arctic elements in repairing the slightest breaches ever made, that period will arrive at last. By that time also new perils at least as apparently insurmountable will have been discovered elsewhere to tempt and recompense nautical audacity.—*London Times*, September 25th, 1880.

RETURN OF LIEUTENANT SCHWATKA'S FRANKLIN SEARCH EXPEDITION.

The members of the Franklin search party, under the command of Lieutenant Frederick Schwatka, United States Army, reached New Bedford, Mass. September 22, 1880, having been picked up by Captain Michael Baker, of the bark George and Mary, of New Bedford, at Depot Island, on the 1st of August, they having returned to that point from their sledge journey to King William Land on the 4th of March of the present year. The sledge journey was the longest ever made through the unexplored Arctic region, both as to the time and distance, the party having been absent from their base of operations in Hudson Bay, eleven months and four days. During that time they traveled 2,819 geographical, or 3,251 statute miles. It was the only sledge journey ever made, that covered an entire Arctic winter.

During the summer and fall of 1879 they made a complete search of King William Land and the adjacent mainland, traveling over the route pursued by the crews of the Erebus and Terror upon their retreat toward Back's River, and while so engaged the party buried the bones of all those unfortunates remaining above ground and erected monuments to the memory of the fallen heroes. Their research established the mournful fact that the records of Franklin's expedition are lost beyond recovery.

The Natchilli Esquimaux, who had found a sealed tin box about two feet long and one foot square, filled with books, at a point on the mainland near Backs River, where the last of the survivors of Franklin's party are supposed to have finally perished, were interviewed by Lieutenant Schwatka. These natives broke open the box and threw out the precious records, which were then either scattered to the winds of thirty Arctic winters, or destroyed by the children, who took them to their tents for playthings. This point was not only searched by Lieutenant Schwatka's party, but by nearly the entire Natchilli nation, inspired by a promise of a great reward for the discovery of any remnant of books or papers no matter what was their present condition. This search failed to discover any of the records but resulted in the finding of a skeleton of a sailor about five miles inland. Its existence was previously unknown, even to local tribes. Every native who could impart any information concerning the lost crews were hunted up and interviewed. Some of them had not seen a white man since Captain Crozier's party was there. The interviews were made through the medium of a competent interpreter, and in this way much valuable information as to the loss of the Franklin records was compiled, It also made known the fact that one of Franklin's ships drifted down the Victoria Straits and was unwittingly scuttled by the Ookjoolik Esquimaux, who found it near an island off Grant Point during the spring of 1849. At that time one man was lying dead in the steerage, and during the same year the natives saw tracks of four white men in the spring snows on the mainland.

The expedition started from the base of operations in Hudson's Bay with but one month's rations of "civilized" food upon their sledges, thus voluntarily submitting to a dependence upon the game of the country through which they passed. The white men of the party began living upon the same fare and conforming to a mode of life strictly in accordance with that of their Esquimaux assistants. The result is shown that it is feasible for white men to adapt themselves to the climate and life of the Esquimaux in prosecuting journeys in Polar regions, and that they are not necessarily restricted to any particular season of the year for that purpose, but can travel at any time and in the same way in which the natives travel. A large quantity of relics has been gathered by the party, not to gratify morbid curiosity, but to illustrate the last chapter of the history of Sir John Franklin's expedition. From each spot where the graves were found a few tokens were selected that may serve to identify those who perished there. A piece of each of the boats found and destroyed by the natives has been brought away, together with interesting though mournful relics in the shape of the prow of one of their boats, the sledge upon which it was transported and part of the drag rope upon which these poor fellows tugged until they fell down and died in their tracks. In addition to these the party secured a board which may serve to identify the ship which completed the northwest passage.

They have also brought the remains of an officer, Lieutenant John Irving, third officer of the Terror, which were identified by a prize medal found in his open grave. The party endured many hardships and were once threatened with starvation, not, as might be supposed, in the course of the sledge journey, but after their return to Hudson's Bay. When the party reached Depot Island there was but one saddle of meat on the sledges, although the return journey was made through a country where game could be procured. This was due to the fact that before the expedition set out, an ample supply of provisions was left in the care of Captain Barry, of the schooner Eothen. He had retained the food on board his vessel, stating that he could take better care of it, and promised to leave it at Depot Island before returning home.

Instead of finding the provisions the party found the natives short of food, as they had been twice before during the same winter, when they were compelled to eat their dogs. Successive storms prevented the hunting of walrus, which is their main dependence at this season. Lieutenant Schwatka's party were consequently for several days without food, and were reduced to the necessity of eating seal skins, walrus hides and other refuse. The conclusion was forced upon the expedition that Captain Barry, for whatever unexplained cause, had left for home, carrying with him the much needed supplies. No material sickness occurred during the absence of the expedition in the field and no severe frost bites were experienced by any of the party.

STANLEY AND THE CONGO.

While nearly all the States of Europe are represented by their explorers in the Dark Continent, America may well be proud that the most important of all the expeditions, the great Congo mission, is under the command of her own representatives, Henry M. Stanley, or rather Dr. Stanley, as he should be called now, since the Imperial Leopold-Carolinian University at Vienna conferred this honorary title on the greatest of all African explorers for his invaluable services to science and civilization. There is but little news from Stanley's expedition, which is still in the camp at Vivi, on the Congo, 130 miles from its mouth and near the second cataract. It is reported that of his eight European companions one has deserted, while three others have already succumbed to the bad climate and exhausting work. One of these was Alexander S. Deane, the engineer of the small steamer, passing up and down the river with stores and mails for Stanley's station. He died suddenly of fever on May 14, at Dutch House, Banana Point, mouth of Congo. Of Stanley's five boats three were temporarily disabled, one large iron launch had sunk, and the chief steamer Belgigne, was at Banana being repaired. Still Stanley's energy is reported to be unimpaired and ample reinforcements are being sent out to him by his employers, the Belgian International Association. Adolph Gilles, who for six years was agent at Cape Palmas and Grand Bassam for a Dutch trading house, left Antwerp on March 25 last, accompanied by Engineer Geoffroy. They expected to join Stanley in fifty days, and will then superintend the erection of his trading stations on the Congo. The chief party of reinforcements, however, was to leave Liverpool before the end of last month. It consists of five Belgian officers, namely:—The leader, Lieutenant Braconnier, of the cavalry; Lieutenants Haron and Valcke, of the Engineers; Paul Neva, of the road and bridge service, and Lieutenant von Hesse, of the Royal Navy. Their exertions will be chiefly devoted to assisting Stanley's efforts in building a road through the wild coast range of mountains, on which he can transport his boats and supplies overland past the terrible series of the thirty-two Livingstone falls. Lieutenant Haron, however, will not join his companions till later on the Upper Congo, as he has been charged by the King of Belgium, who is president of the International Association, with a secret mission to Africa which may occupy him for ten months, whereupon he will join Stanley. He sailed August 23 for his new destination.

OTHER CONGO EXPEDITIONS.

Besides Stanley's expedition some other attempts are also being made to explore the great Congo. Mr. McCaul, of the Congressional Inland Mission, has already left England for the west coast in order to make his way into the interior by the northern bank of that river, while the Baptist Missionary Society have sent out Mr. W. Comber. He left England on April 26, 1879, landed at Mussuka, on the Congo, July 2, and reached San Salvador south of that stream. He there established a depot, leaving two of his companions, and went on with a third to Stanley Pool, above the falls, in order to establish there a second station. If he succeeds the mission will attempt to transport a small steamship to that navigable part of the Congo, Robert Arthington, of Leeds, having offered the society $20,000 in aid of this Congo special mission, and particularly for the purchase and perpetual maintenance of a steamer on that river and its affluents. He also stipulates for the establishment of mission stations at the mouths of the great tributaries, Ukuta and Ikelemba.

PROPOSED AUSTRIAN EXPEDITION.

The Vienna Geographical Society has issued an appeal for subscriptions for an Austrian expedition, which Dr. Emil Holub has decided on undertaking. Dr. Holub intends crossing the whole length of Africa, from south to north. He will start from the Cape of Good Hope and penetrate to the Zambesi, thence explore the Maruthemambunda territory, the water-shed district between the Zambesi and the Congo, visit the lake sources of the Congo, and from there through Danfur he will try to reach Egypt. Dr. Holub expects the journey to extend over three years. The expenses, he reckons, will amount to about 50,000 florins, 5,000 of which he can himself supply.

M. SIBERIAKOV'S EXPEDITION TO THE YENISEI.

News has been received from the steamer Oscar Dickson, which, with its proprietor, Siberiakov, on board, set out some time ago to penetrate through the Arctic Sea to the Yenisei. The ship and crew on the 19th of September were in excellent condition at Kabarova. They had met with great difficulties, and had so far been unsuccessful in their object, but were on the following day to make a fresh attempt to find a passage through the Sea of Kara.

A PRIVATE ARCTIC VOYAGER'S EXPLORATIONS.

A telegram dated Hammersfest, September 25, has been received from Mr. Leigh Smith, a private gentleman, on a summer voyage in the Arctic regions in his own steamer. He states that he made Franz Joseph's land August 14, and explored the west coast to 80° 30′ north latitude and 40° east longitude. He could see land forty miles beyond Markham; says this is the best done yet in this direction. Mr. Smith closes his dispatch with the statement that the exploration of the Pole is not impossible.

ENGINEERING.

THE C., B. & Q. RAILROAD BRIDGE AT PLATTSMOUTH, NEB.

BY A. L. CHILD, M. D.

We approach this bridge from Plattsmouth on the west bank of the Missouri river by a side hill cut and embankment, down the river one-half mile, and then enter a cut through the river bluffs of another half mile ranging from eighty-five feet as a maximum depth, downward.

This cut exhibits several features of interest to the geologist.

It is entirely within the loess formation, the whole body of which, in this cut, is permeated with cracks of from one-fourth inch to four inches in width, running in various directions, which have been filled with a carbonate of lime. This lime hardens to a strong crusty substance on exposure to the atmosphere, and then, as the surface of the cut disintegrates and falls away, these seams of lime are left projecting beyond the surface.

These cracks are probably the result of earthquake action in some past time.

Again, the sides of the cut, under an almost continued change of direction, offer exposures to any and every point of compass; and thus, in its different parts, it is subject to all grades of storm action. And as these storms act with more or less force upon the surface, they leave different but very positive evidences of stratification and consequently of subaqueous deposits.

As we approach the east end of the cut, we pass the debris of an iceberg which stranded here in the earlier ages of the loess deposition.

We now enter upon the west end viaduct, an iron structure of one hundred and twenty feet in length, and some fifty feet in height.

This short viaduct bears us to pier No. 1, on the west bank of the river. This pier is founded on rock thirty feet below low water mark. The excavation for it was made in a coffer dam through sand, blue clay and boulders. The coffer dam was filled with beton and rubble stone; and masonry began at two feet below low water and was raised sixty-two feet above.

The bridge proper, of two spans, each of four hundred feet, commences here; the eight hundred feet reaching the east bank of the river at ordinary stages of water. The bridge of steel and iron is elevated on its three piers sixty-two feet above low water, and with its network of posts, webs, ties, struts, etc., the superstructure rises fifty feet above the piers. It is a Pratt or Whipple truss structure with inclined end posts, the web being arranged with double intersections.

Each span has sixteen panels of twenty-five feet each.

The ties are in two lengths and couple on pins passing through centers of the posts. Attached to these pins a strut extends between each pair of posts, and a system of diagonal wind bracing connects these struts with the top lateral struts.

The middle of each inclined end post is supported by a horizontal lattice work strut, which reaches to the first vertical post.

The floor beams are riveted to the posts immediately above the bottom chords, and act as lateral struts, the lateral ties being coupled on pins passing through jawnuts screwed on ends of the lower chord pins.

The stringers are riveted to the webs of the floor beams.

From pier No. 1 we pass to pier No. 2. This pier is midway over the river, four hundred feet from pier No. one, on the west bank, and the same from No. three, on the east. This pier is based on rock thirty-two and a half feet below low water, by sinking a pneumatic caisson, twenty-one by fifty-one feet, through fifteen feet of sand. This is surmounted by a timber crib-work filled with beton. The masonry was begun at two feet below low water. Like numbers 1 and 3, this pier rises sixty-two feet above low water to the railroad bank.

Another four hundred feet and we reach pier No. 3, on the east bank of the river. This pier is based on rock fifty-two feet below low water, and was built in a pneumatic caisson, the same as No. 2. The masonry was begun six feet below low water. At this point the entire height, from the base of the pier up to the top of the bridge, is one hundred and sixty-four feet.

These piers, one, two and three, have all the same general form, their several tops the same sixty-two feet above low water. Under the coping courses they measure eight by thirty-three feet, the ends being circles of four feet radius. They are built with a batter, or slope, of one-half inch to the foot on sides and ends. At thirty-four feet below the coping courses, the ends are changed to a pointed form, the lines being arcs of circles, struck from points seven feet apart. At the foot of the battered work the piers are thirteen by forty-four feet. They are of first class rock-faced masonry, laid in Portland cement and backed with béton. We now leave the channel of the river and pass on over the three deck spans, of two hundred feet each. At two hundred feet from pier No. 3. we reach pier No. 4., which is based on rock fifty-four feet below low water and built as two and three, in a caisson eighteen by forty feet, through sixty-five feet of sand. The masonry of No. 4 begins at one foot above low water, on the top of fifty-five feet of béton.

Pier No. 5 rests on seventy-eight piles driven inside of a curb eighteen by forty feet to an average depth of thirty feet below low water. These piles are capped by a grillage, and bedded inside the curb in béton; the masonry begins at low water.

Pier No. 6, is founded on concrete twelve by thirty-three, and three feet deep. The masonry of piers four, five and six measures seven by twenty-seven feet under the coping. Each has semi-circular ends, and is about thirty feet in height. The three deck spars rise on these piers to a height of about thirty feet, they are of the "Pratt" truss, with single intersection-webs and inclined end-posts, and have eight panels, each of twenty-five feet. The floor beams rest on the top chords, and the track stringers are riveted to the webs of the floor beams.

Leaving the six hundred feet of deck spans behind, we pass on to an iron viaduct of fourteen hundred and forty feet in length, and ranging from thirty to twenty-five feet in height; consisting of forty-eight spans of thirty feet each. On this viaduct the floor system is uniform with that of the preceding five spans, viz: The track stringers are spaced nine feet between centers, thereon rest nine by nine inch oak ties, spaced fifteen inches from center to center, leaving open spaces of six inches. These ties are generally twelve feet long, and locked on each end by 10x10 inch guard rails. At intervals of five feet a sixteen foot tie projects on each side of the track to support a foot-walk, and at intervals of twenty-five feet ties of eighteen feet length are introduced to support at each end an iron stanchion, through an eye in the top of which a three-fourths inch wire cable traverses the nineteen hundred and sixty feet of iron and steel work, for hand rails. Three by four inch guard angle irons are also bolted to the ties six inches inside of the track rails, to guide trains accidentally leaving the rails.

Having passed the viaduct, we enter upon a temporary wooden trestle work of two thousand feet in length, containing one hundred spans of twenty feet each from twenty to thirty feet in height. This trestle work is for temporary use until it is buried in an embankment which is rapidly progressing. Beyond this trestle work an embankment extends about one and a half miles, ranging from twenty-five five to feet in height.

A summary of the whole work, cut, bridge work and embankment, makes it about three and a half miles long. Iron and steel structure, twenty-nine hundred and sixty feet, and wood two thousand feet. Of the two four hundred feet spans, the top and bottom chords, inclined end posts, main and counter ties, lateral rods, pedestals, rollers, and all chord and lateral pins are of steel. The intermediate posts, end suspenders, lateral struts, portals, stringers and floor beams are of iron. The three deck spans are entirely of iron except the pins, which are steel.

It requires considerable thought to realize the value of the numbers representing the quantity of material required for the entire work. Of steel five hun-hundred tons were used. Iron in the viaduct, four hundred and forty tons; deck spans, four hundred and eight tons; bridge proper, three hundred and twenty tons. Total, eleven hundred and sixty-eight tons. Timber, in wood trestle, four hundred and forty thousand feet, (board measure); foundation of bridge, five hundred thousand feet; oak in bridge floor, three hundred and seventy-five thousand. Total, one million, three hundred and fifteen thousand feet, besides a large amount of piling, false or temporary supports, etc. Masonry in the six piers, twenty-seven hundred yards; in abutments and trestle work, eleven hundred yards. Total, thirty-eight hundred cubic yards. Béton work, six hundred and fifty cubic yards.

The entire structure was designed by Chief Engineer George S. Morrison and executed under his direction, assisted by First Ass't Engineer, H. W. Parkhurst and Ass't Engineers, C. C. Schneider, B. L. Crosby and W. G. Dilworth. The two four hundred foot bridge spans were manufactured and erected by the Keystone Bridge Company of Pittsburg, Pa.

The entire cost of the whole structure when completed, will be under seven hundred thousand dollars.

On August 30th, 1880, the strength of the bridge was tested by running on each of the two four hundred foot spans alternately, and over the entire structure eight locomotives loaded with coal and water, and concentrating a total weight on each bridge span of about four hundred and fifty tons, under which a deflection of three inches only was produced.

For the foregoing description I am largely indebted to Messrs. Geo. S. Morsison and H. W. Parkhurst, Chief and Ass't Engineers on the bridge, and to articles published by them in the "*Engineering News*," from which I have freely quoted.

RAILROAD BUILDING IN THE ROCKY MOUNTAINS.

The Denver & Rio Grande Company is at present engaged in constructing extensions in seven directions: from Alamosa to Silverton; from San Antonio to Santa Cruz, New Mexico; from Cañon City to Silver Cliff; from Leadville to Kokomo; from South Arkansas to Gunnison; from Poncho to Maysville, and from Malta to Eagle River. These extensions aggregate new track, four hundred and forty-six miles in length. For the reasons that it has to be accomplished in the face of great natural difficulties, through an exceedingly mountainous region and will open and make of easy access a region of vast mineral wealth beyond the Continental divide; for these reasons the extension to the San Juan has aroused a more general and lively interest than the others.

From Alamosa the Rio Grande track proceeds to San Antonio, a station about two miles from the town of Conejos. At this point the New Mexico branch reaches out southward and the San Juan branch turns toward the west. The distance from Alamosa to San Antonio is twenty-nine miles. The latter station is practically the material camp of the Extension company, and the not very thickly populated lots and blocks of the town are covered with fields of steel rails, bolts, bars, etc., waiting for the demands of the contractors at the front. There are at this point or on the line of the road ready to be forwarded, rails sufficient to iron sixty miles of track. At present iron is being received at Denver for reshipment south, at the rate of one mile per day.

It is between this point and the Pinos Chama divide, the terminus, that the

Extension company has accomplished the most difficult work on the branch. The distance from Boydville to what is called Los Pinos cañon, beside which the iron is now being extended toward Chama Peak, is fifteen miles, and the construction of the rail route has required not only a vast outlay of money, but the services of the most skillful engineers, sustained and directed by the greater courage and sagacity on the part of the company, and the employment of thousands of mechanics and laborers. In making the distance between Boydville and the terminus, three low ranges and as many deep valleys have to be crossed. To ascend these mountains, then reach the valley and climb again the steep beyond would have been impracticable, and to surmount the difficulty it has been necessary to follow along the side of the mountain on a uniform rising grade, skirting the valleys, and gradually gaining a higher altitude until the last level before the great divide has been reached. It is along this portion of the road that the most enchanting view of glade and cliff and torrent, of creek, of valley and of mountain top, is presented.

There are two tunnels on this piece of road ; one through what has the form of an immense concrete hill and the other through solid rock. An idea of the magnitude of this achievement in railroad building may be gathered from the knowledge that to cover a distance of one-half mile in a straight line, it has been necessary to construct two and one-half miles of track, trestle and embankment, and one mile of this cost $140,000. The curves in some instances are very sharp, but the steel rails were shaped according to minute specifications before they reached the place where they were to be laid, which required the utmost exactness. The outside of each curve is closely and firmly secured by brace chairs, while the inside is as strongly supported and secured as possible. But perhaps the most noteworthy feature of this piece of track, which has been called the "Three-Ply," is the uniformity of the grade. There is no doubt that an operative route from the San Luis to Pinos Chama could have been laid with shorter distance and far less expense, but the easy grade would not have been gained. As it is, the forty miles between San Antonio and Pinos cañon is, if anything, less inclined than the grade between Denver and Pueblo, and the same weight of train can be hauled over these mountains as can be carried along the Denver division.

The present objective point of the San Juan extension is Silverton via Animas City. By far the most difficult portion of the route has been accomplished and beyond the terminus now gained, over forty miles of road-bed is practically ready for iron, which is being stretched at the rate of one mile per day. Just beyond, perhaps five miles from the tunnel, on the Pinos Chama divide, the railroad crosses or meets the Los Pinos toll-road, and the point will be known as the Toll Gate. This is the regular wagon road to the San Juan, and will be the first transportation conjunction between steam and mule power. After Chama is reached work on the extension will not be in the least delayed by snows or winter weather. By the middle of January the track will be in the valley of the San Juan and in the early spring the locomotive will steam into Animas City.

The San Juan extension, or branch reaching from Alamosa to Silverton, will be 228 miles in length. The line of the road enters New Mexico three times, the second entrance making a run of about thirteen miles. The branch also passes through a portion of the Ute reservation, the entrance upon Indian ground being at a distance of thirty miles probably from Chama summit, or forty miles from the present terminus.

The grade from Animas to Silverton; over a line nearly due north, is natural and easy and will require but very little work as compared with other portions of the route. There is one cañon near Silverton somewhat difficult of passage and a force of men has been at work there for some time making ready thus far in advance for the grading party, which is rapidly and persistently going ahead. It is now confidently believed that Silverton will be reached before the autumn leaves fall next year.

Regarding the other extensions, it will be appropriate, as showing the extent of advancement now being made by the Rio Grande, to refer to them in this connection. The New Mexico line anticipated a length of ninety-one miles due south from San Antonio to Santa Cruz. The latter point is twenty-four miles west of Santa Fe, which places the narrow-gauge within a few hours' stage ride of the New Mexican capital. Of this distance, sixty-five miles have already been ironed, and the entire length of this branch will be in operation by November 10th. Three hundred track-layers are now at work on this extension, and all the grading has practically been done. Track is going down at the rate of half a mile a day, and if a deep and difficult rock cut had been completed the Rio Grande would have been reached before this.

The Gunnison branch starts out from Cleora, or South Arkansas, proceeding to Poncha, a distance of five miles. Here the road parts, one branch leading up to Maysville, eight miles, and the other or main line going via Marshall Pass to Gunnison City, sixty-five miles. The grading on the Maysville branch is very light, as cheap as the Platte valley. The Gunnison line is more difficult, but nothing as compared with other achievements of the company. It is expected that track laying will begin on this line within ten days and it will be pushed with all speed.

The branch from Leadville to Kokomo is nearly completed, and within twenty days trains will be in operation. This branch is twenty miles long and will be extended to Breckinridge right away.

Two hundred men are at work on the branch from Malta to Eagle river, which will be thirty-one miles long, the objective station being Red Cliff. It is confidently believed that the line will be in operation early in the Spring.

On the Silver Cliff extension from Cañon City, three hundred men are employed, and every exertion is being made to complete the road as early as possible. The line has been graded for nearly twenty miles, and as there is little fear that the snow will halt the work, the entire distance of thirty-one miles will doubtless be accomplished some time during the month of January.—*LaPlata Miner.*

VELOCITY OF SHOT, WITH SUGGESTIONS TO SPORTSMEN.

As a result of laborious and scientific experiments, Professor Mayer, in his paper on this subject before the American Science Association, presented the following tables:

Size of shot.	Vel. at 30 yds.	Vel. 40 yds.	Vel. 50 yds.
I. 10 Colt gun, 5 drs. Curtis & Harvey powder, 1¼ oz. of shot.			
No. 1 buck	1,147	1,132	—
FF	1,146	1,126	—
BB	1,153	1,067	—
No. 3	1,066	1,015	928
6	1,012	963	859
8	995	880	775
10	908	803	716
II. 10 Colt gun, 4 drs. Curtis & Harvey powder, 1¼ oz. of shot.			
No. 1 buck	1,067	1,018	—
FF	1,017	1,009	967
BB	1,000	967	897
No. 3	989	911	872
6	966	883	806
8	920	874	776
10	848	756	669
III. 12 Colt gun, 3¼ drs. Curtis & Harvey powder, 1⅛ oz. of shot.			
No. 1 buck	—	703	—
FF	—	—	706
BB	862	795	667
No. 3	844	754	696
6	825	739	600
8	816	749	607
10	796	680	610
IV. 12 Colt gun, 4 drs. Curtis & Harvey powder, 1¼ oz. of shot.			
8	847	722	671
10	748	657	596

A glance at these tables at once shows the rapid increase in the velocity of gunshot from No. 10 up to No. 3. With the heavier pellets the increase in velocity is less marked. Thus, the table headed "12 Colt gun, 4 drs. Curtis & Harvey, 1¼ oz. shot," shows that No. 8 shot has 71 feet per second velocity over No. 10 shot, and No. 6 has 47 feet over No. 8, while No. 3 has only 23 over No. 6, and BB shot gains only 11 feet over No. 3. The relations between velocity and weight of pellet shown in this table may be taken as a type of all the experiments, and I have projected them into the accompanying curve, the units of whose axis of abscissæ are units of weight, and the units on the axis of ordinates equal four feet of flight of pellet. The next fact, and an important one to sportsmen, which is shown by these experiments is this: If the same charges of powder and shot (4 drs. powder and 1¼ oz. shot) be fired from a 10 gauge and from a 12 gauge gun we get a velocity of 100 feet per second in favor of the 10 gauge. This is conclusively shown in the comparison of the figures in the tables headed "10 Colt gun, 4 drs. C. & H., and 12 Colt gun, 4 drs. C. & H., 1¼ oz. shot." With No. 10 shot the mean velocity over the first 30 yards given by the 10 gauge gun is 848 feet; with the same shot and charge in the 12 gauge the velocity is 748 feet, a difference of 100 feet in favor of gauge No. 10. With No. 8 shot the difference is 72 feet. The average difference in favor of the 10 gauge in the flight of No. 8 and 10 shot over 40 yards and 50 yards amounts to 110 feet.

I trust that these results will show to sportsmen and the makers of guns that the recent movement in favor of small bore guns is one in the wrong direction. If any gunmaker will make a 10 or even an 8 gauge gun, weighing about 7½ pounds, the sportsman will have the best fowling piece for upland shooting. The reason why a 10 guage shows such superiority over a 12 gauge is that the same charge of powder and shot occupies less *length* in a 10 than in a 12 gauge, hence there are fewer pellets of shot in contact with the barrel of the 10 gauge to oppose by their friction the projectile force of the powder; and, secondly, the powder in a 10 gauge gun is exploded nearer to the center of its volume, and thus the powder first exploded does not have so much chance of blasting before the unburnt powder contained in the charge is removed from the point of ignition. I also venture to predict that, with the same weight of barrels, the 10 gauge will not heat as much as the 12, because the motion of the shot lost by the greater resistance it opposes in a 12 gauge cartridge must appear in the form of heat. The third fact which these experiments show is that the proper charge of shot in a 12 gauge gun for upland shooting is 1⅛ oz., and not 1¼ oz., as has of late years been the practice to use; for the tables show that with 1⅛ oz. of shot and 3⅛ drs. of powder an average velocity is obtained, which requires 4 drs. of powder to give to 1¼ oz. of shot a velocity equal to that given by 3¼ drs. to 1⅛ oz. Now 4 drs. of powder, if not fired from a gun weighing at least 9 lbs., and from a good, strong, muscular shoulder, is disagreeable. The effect on the body, and especially on the brain, is neither conducive to pleasant or good shooting. The number of pellets in a charge of 1¼ oz. of No. 8 shot is 499. In a charge of 1⅛ oz. of the same shot there are 449, therefore only fifty pellets more in a charge of 1¼ oz. than in a charge of 1⅛ oz., and surely the want of the 50 will not cause a good shot to miss his bird with 449 pellets, nor will the addition of the 50 give a bad shot more chance of bringing his bird to bag with his 449 pellets.

I wish now to show to the Association, and especially to those members of it who are sportsmen, other applications of these experiments to the art of shooting on the wing. There are two styles of shooting on the wing. One is called "snap shooting," when the shooter, on selecting the bird which he wishes to bag, quietly brings the gun to his shoulder, and at the instant it is in place fires. If the bird is a cross-shot, he determines at the moment of fire the distance to which he should direct his gun ahead of its flight, this distance depending on the veloc ity of the bird's flight and on his distance from it. This manner of shooting practiced the more generally by upland gunners in shooting quail, grouse, and woodcock. The other style of shooting may be designated as "the swing shot," in which the gunner swings his gun ahead of the cross flight of the bird till he attains the proper distance ahead of it, and then fires, but keeps his gun moving with a regular angular velocity till even after its discharge. This method of shooting is, in my opinion, and from my experience, the proper method; and is certainly the only one which has been found successful with shooting of bay fowl —as ducks, brant and wild geese. Yet there are sportsmen who will contend that they merely follow the bird with the gun, and discharge it while it is pointing at the bird. I put this opinion to the test this summer in the following manner: Four willets came over the decoys, flying in line with a good speed. With my gun I followed the first bird, coolly and accurately, and kept the gun moving regularly after its discharge. Instead of killing the first bird, the third from the leader dropped dead. To give a rule applicable to all gunners as to the distance at which a gun should be pointed ahead of a bird, is not possible. Some sportsmen follow a bird, and then, after reaching before it the proper distance, suddenly stop the angular motion of the gun and then fire. Others, after following the bird a short distance, give a quick lateral motion to the gun and then fire. Others, again, bring the gun with a lateral motion ahead of the bird, and keep the gun moving till their experience decides the proper distance ahead of its flight, and fire while the gun is keeping its previous regular velocity. For the simple illustration of the bearing of these experiments on the art of shooting on the wing, I will suppose that at the moment of fire the gun is stationary; in other words, that we are firing "snap shots." If the bird has a velocity across the line of flight of 30 miles an hour, and we are using charges in a 12 gauge gun of 3¼ drs. of Curtis & Harvey powder and 1⅛ oz. shot, we will have to shoot about 5 feet ahead of the bird if it is flying at a distance of 30 yards at 7 feet ahead; if at a distance of 40 yards, and 11 feet ahead of the bird if at a distance of 50 yards. These distances ahead for cross shots at birds flying at the rate of 30 miles an hour may appear out of all reason with the experience of many sportsmen; yet if you will place a stick 5 feet long at 40 yards and ask the same gunners if they would hold ahead of a bird by that distance if it were going with a velocity of thirty miles, I venture to say, from my experiments with them, that they will say, "Of course, that is only about 18 inches;" so difficult is it to determine a length at a distance while sighting along the barrel of a gun. I will conclude with the remark that this paper will not make a good shot on the wing, no more than a description of how to perform on the violin will make an accomplished violinist. It has been said, perhaps rather strongly, that a "pedagogue can teach to read and write, but a crack shot is the gift of the gods."—*Scientific American.*

APPLIED SCIENCE.

THE NATURAL SCIENCES: THEIR NEWNESS AND VALUE.

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Science is classified knowledge. We may know never so many isolated facts, and yet our knowledge be unscientific. In fact, we all do know a great deal about ourselves and our surroundings, and yet, because we do not understand the relations existing between the facts with which we are familiar, we cannot say we are versed in science. Now, natural science is the classified knowledge of the material world—it deals with matter, the phenomena exhibited by and in matter, and forces, or the causes of phenomena. Natural science may be discussed from several standpoints, but in this paper, the subject of the newness and the value of the natural sciences will be considered.

Knowledge is a thing of growth. The new-born babe is utterly ignorant and acts only as impelled by instinct. But within this same infant brain are infinite capacities for acquiring knowledge. Newton, Galileo, Agassiz, all the proudest masters of the human race, were once helpless babes. And yet, in the course of four score years they comprehended much of the mighty forces of the universe, and understood a multitude of the facts and phenomena of matter.

Now, just as any individual of the human race grows from infancy and ignorance to old age and some degree of knowledge, so the human race itself must have had its period of infancy and ignorance, and has been, and is yet, growing toward seniority and a wider acquaintance with the universe. If this be true, then if we can find the order in which an individual acquires knowledge, we will also know the order of the growth of knowledge among the human race.

During its earliest years the child learns to eat, to laugh, to cry, to walk, to talk, to sing, to climb, and to do numerous other acts by imitating the example of the elders about it. Ideas of distance, size, surface and other qualities of matter are not acquired until several years are past. Proper conceptions as to them must be gotten by personal experience. Then, as years of maturity approach, ideas of relation and of laws begin to come to the mind through inductive processes Hence knowledge may be classified as (1) Imitative, (2) Experimental, (3) Inductive.

Let us apply this order of advancement to the human race. After the birth of the human race, there were long ages which we may term its infancy, during which the struggle for existence dominated and curbed all mental advancement. Means for defense against savage men and still more savage beasts, and methods of procuring sustenance and bodily comfort occupied the entire thoughts of men and left them time for nothing else.

Gradually, however, this period passed away, and the era of imitation began to develop itself. What constitutes the knowledge of man which may be called imitative? For answer let us look to history. Out of the dim mists of the past we gather the grandest forms of poetry, oratory, sculpture, architecture, etc., that the world has ever seen or can see. And why? Because they are all imitative in their origin, and employed the minds of men during the childhood days of the human race. For instance, let us consider sculpture. From the hands of the Creator—the Master of the universe—came models as perfect as could be. Forms of men, of animals, of trees, of all natural objects were perfect. There was only required in man genius with suitable materials placed at its disposal to produce an imitation as nearly as possible like the original model, and afterward it would be impossible to go any further in this line. As to painting, nature showed the landscapes, the light and shadow to colors, and the artist must only copy the objects correctly and color them properly, and human hand could do no more.

In architecture, the growth was somewhat slower, and yet the noblest forms and most admirable styles were early reached. Language was another imitative acquirement. The earliest words, I doubt not, were articulated in imitation of sounds produced by various animals or various phenomena. Soon all the more noticeable objects and acts in any locality had received names, and these names became fixed for that locality. They descended from father to son and were carried in their migrations from one country to another. Thus spoken language began. Written language was a thing of later birth, and grew out of signs and symbols made to represent things. The earliest written language of human origin is hieroglyphic. The multiplication of symbols, as knowledge increased, led to the adoption of a few artificial characters as symbols of sounds, which, being combined, would represent all objects and phenomena whatsoever. Then as soon as possible came the poets and historians, who gathered up the traditions of their peoples and wrote them down, They appropriated all the imagery and tropes and figures of earliest speech, and left behind them works which lose no luster with the flight of years. After them, everything must be taken second-hand—the best had been done. Out of the written language arose grammar, rhetoric, etc., as the laws of both spoken and written language. The science of numbers arose partly from imitation and partly from experiment. The rise and set of the sun would naturally become the unit of measure of time. The course of the four seasons, and their constant recurrence in the same order would fix the length of the year. In measuring magnitudes, what more easy of access than the hand, or arm, or foot, or stride, or height? Men having become accustomed to the use of these, the need of uniformity would lead them to adopt a measure taken from the arm or foot of a king or leading man. A unit once adopted would be handed down, as our yard stick, which dates from the reign and arm of Henry I. of England (1120 A. D.) The origination of a system of notation and numeration soon followed, to be transmitted from generation to generation.

Now, the sciences we have thus far glanced at were to a greater or less degree imitative; and the fundamentals of them were such that, once established, they became enduring. As the purposes they served were equally applicable in all places and times, by migration they spread over the earth and by transmission passed down from father to son. And to-day we make use of artificial standards, of artificial letters, of words long coined, of much imitative knowledge, nor ever spend more time upon them than is necessary to fix their names and meaning in our minds.

But now let us turn to the second kind of knowledge—the experimental—and trace its origin and growth among the human race.

Just as the experimental knowledge of the child arises mostly from contact with Nature, so the experimental knowledge of the race must be, for the most part, a knowledge arising from contact with Nature. Now, though the fundamental ideas in the natural world are few and everywhere the same, yet in the execution of these few ideas there is such endless variety that the natural conclusion in regard to them would be, especially to a casual observer, "There is no law in Nature—all is confusion and chance." The people of one region, migrating to another more or less remote, would find an almost entirely different phase in Nature and the phenomena it exhibited—especially of plant and animal life, which lends so much to the formation of variety in nature as presented to us in various places. Varieties of climate, differences of heat and cold, of rain and wind and length of day and night—all these and many other things would lend very little encouragement to the student of Nature. Had an observer lived long enough in one place to know well by experience the general features of that locality, yet removal to another might present such contradictions as to shake his confidence in his former observations. All such experience rendered the knowledge of nature a thing of slow growth. Before it could be found that under all the variety of external nature ran an undercurrent of unvarying sameness and that all phenomena occurred in obedience to inexorable law, it was necessary that ages should pass away, that the human race should inhabit the whole world, that easy means of communication should be invented, that civilization should spread abroad its benign influences, that peace should link in friendly communion the nations of earth, that life should grow less imburdened with the struggle for existence and have more of leisure, and lastly, that multitudes of observers in all quarters of the globe must carefully and faithfully record their observations from year to year through many generations. But none of these conditions existed during the early ages of the human family. And therefore the sciences of nature were of very slow growth. Because very much of the heavens above us is always visible at night, and because the stars are always beautiful and attract attention, it was very natural that the science of astronomy should take some form at a very early date. Except astronomy, however, none of the natural sciences assumed any valuable form until within the most recent times. The last three centuries have witnessed the birth and growth of nearly all that we call natural sciences. Even our own lives are contemporary with constant advances, conquests and developments in the domain of nature; while the sciences of language, figures and so forth have grown hoary with years of maturity.

The order of development of the various branches of natural science would be from those of tangible matter, as physiology, zoölogy, botany, mineralogy, to those of intangible matter and the phenomena and forces of matter—for which reason chemistry is hardly a century old and meteorology is yet in its childhood. The course of progress has been from molar to molecular—from worlds to atoms —from simple to complex: evolution is the term to apply to the growth of knowledge as well as to the growth of material order. Hence the natural sciences are new—and are new of necessity.

And just here let me throw in a word on the subject of the inspiration of the Scriptures. Modern research as to the history of the earth has developed facts which most harmoniously agree with the record of creation as given in the first chapter of Genesis. If it be acknowledged that all the observations of many men for many years were necessary to unfold the order of development of the earth, and that the facts in the case have only lately come to be known, viewed from a natural standpoint, then whence came the wonderful information of the writer of the book of Genesis? Certainly it was not of human origin. Therefore we are driven to the conclusion that it was of divine origin. I think this a very powerful argument in favor of the inspiration of the Scriptures.

Having discoursed at some length on the newness of the Natural Sciences, let us come now to the subject of their value. We now enter upon ground over which many mighty and stubborn conflicts have been waged, the combatants being the adherents of Imitative Knowledge against the followers of Nature. Because the Imitative Sciences are almost as old as the race of man, of course they have almost up to the present time been foremost in the minds of men. It is a well-known fact that any party in power has always struggled to keep down an opponent, though the success of either meant the same good for all. Following this law, the advocates of Imitative Knowledge have beheld with jealous eye the growing favor of the Natural Sciences; and the war yet goes on, though with diminished fierceness.

To-day I plead the cause of Nature, and claim for its sciences as important places in our schools as are now occupied by the sciences of language, figures, etc. Please note well that I do not ask for them more prominence, but equality only.

Let us compare briefly the methods of study and results obtained in each course, and then we can better compare the value of them in their influence upon the human mind.

Here is an old fashioned school. The principal duties are spelling, reading, arithmetic, grammar, etc. Day after day and year after year the children gather in with their printed books and con over the pages of uninteresting matter. Long wordy rules are memorized and recited, but the recitation is that of the parrot; the philosophy of them is not understood at all. How well we all remember the rules of common fractions, of square and cube root, of syntax! And to-day the majority of children are ground through the educational machine in the same old way; and when they are asked for reasons for the answers given when questions are propounded, they are sure to reply "the books say so." The old system has very little in it to make independent thinkers. It is no wonder that for ages in the olden times only one system of medicine was in vogue—public opinion compelled all to follow in the footsteps of Hippocrates and Galen. It is no wonder that the masses of the people at the present day are startled into open-mouthed wonder by the veriest knaves, and are led off after will-o'-the-wisps because they appear to be something of worth. The majority of people are guided by external appearances—just as they were in going through their text-books—nor ever seek for undercurrents or causes.

But now let us look in upon a school where Nature is unfolded to the children—or rather by the children. No text-books are used in the lower grades—only the wide-spread volume of Nature is kept before them. They are directed to bring in leaves, or flowers, or insects, or rocks, or anything else of manifold Nature. Attention is directed to differences and resemblances.

A fundamental idea or two is given to them by the teacher, and then they fully verify these ideas by examining the objects in hand. The fact becomes each child's personal property, not because book or teacher says so, but because they themselves, by personal experience, have proven it to be true. It has become verily a part of the child—a solid growth. Having grasped in this way a few fundamental ideas, the process of sub-dividing according to some prominent characteristic, apparent in many of the objects at hand, easily follows; and soon analytic and synthetic processes, based on personal observation and thoroughly to be relied on, because matters of personal experience, produce a strength of mind and independence of thought not to be acquired in any other way. As far as anything pertaining to the material world goes, they become strangers to credulity, and only that is accepted as truth which has been tried and stood the test. I grant some may drift into infidelity because they attempt to prove all things both finite and infinite, and fail; but I would rather have some infidelity among much strong wisdom, than all-abounding credulity.

Thus far I have considered the value of the Natural Sciences as subjects of mental discipline in our schools. But the study of Nature has other points of value. It affects our personal welfare. Nature is all about us—ourselves the highest and noblest factors in it. To make our personal welfare the best possible, we should know ourselves; but a full knowledge of ourselves demands acquaintance with all that can affect us in any way: we are affected by universal Nature. We live continually in the presence of Nature and behold constantly its phenomena. If we know not the relations existing between ourselves and the phenomena we behold, then we are apt to be like the people of old—superstitious and forever in dread. But beyond the mental effects we may experience, there are others of much more importance—even physiological ones.

This human body is strangely and wonderfully constructed. A grain of one substance may nourish, of another cause instant death; one plant may furnish delicious food, another deadly poison. We should all certainly know the value of one organ of the body above another. We should all know how murderously ruinous it is to constrict the organs upon which the very life depends. We should all know enough of human physiology to understand that the cramping of the Chinese foot is less suicidal and barbarous than the constriction of the American chest. We should all understand Nature well enough to know that violation of her laws will surely be punished—that she permits no sinning on her estates. Were all properly versed in Nature and her laws, "perpetual motion" and kindred topics would drop into utter oblivion. But we must pass on. From a social standpoint, the study of Natural Science is valuable. Nature presents herself in multitudinous aspects, and no two eyes ever see just the same aspect. Hence the experience of each mortal observer is different, in a greater or less degree, from that of all others of his human kind. Hence if all should be tutored in the great fundamentals of Nature, then when the social company was assembled, subject for conversation need never fail. There would need be no silent sitters because the topic in hand was one never studied—was one of which they had no experience. Of a natural tendency to use Nature as a subject of conversation, note how people universally say "good morning," "rainy day," "disagreeable night," etc., when greeting each other.

Again the study of Natural Science has its value to the teacher. All through the country, in every district school, what a glorious chance for the teacher to lead the children away from the dry tasks of text-books and regale them at the feast of Nature forever and unstintedly spread out around the door! In Summer and Autumn, in Winter and Spring, an endless profusion of objects and changes invite to their study—a study that is a pleasure and not a task.

Lastly, and rising in value far above all things we have mentioned, the study of Nature expands our souls as well as our intellects. Studying Nature, how easy it becomes to look for and adore Nature's God—the Creator of all! What study of letters, or grammar, or figures, or problems, ever appeals to anything but the intellect? But the study of Nature presents such evidences of beautiful design and such unapproachable wisdom that the intellect bows down before it and sends its high priest—the Spirit—into the Holy of Holies to worship at the shrine of the Omnipotent One. After that we live nobler lives and pay deeper devotions to "Our Father who art in Heaven."

I sum up as follows:—

Science is classified knowledge, and may be divided into

1. Imitative Science;
2. Experimental Science;
3. Inductive Science.

Natural Science is *new*

1. Because classified knowledge of Nature is of recent origin;

2. Because new phases are ever being unfolded to us;
3. Because Nature, as a whole, never grows old.

Natural Science has *value*.

1. It develops the analytic and synthetic powers of the mind, and makes independent thinkers;
2. It affects us personally, keeping us from superstition and helping us to know and preserve our frame;
3. It affects us socially;
4. It aids the teacher in teaching;
5. It reaches the soul as well as the intellect, and leads us to God.

HISTORY OF THE STEAM ENGINE.

FROM PRESIDENT R. H. THURSTON'S INAUGURAL ADDRESS BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, NOV. 4, 1880.

As an illustration of the method in which advancement occurs, and as an example of the kind of work which remains for us to do, let us glance, very briefly, at the history of that greatest of modern triumphs of mechanism, the steam engine.

Away back, twenty centuries and more, in the dim past, among the first faint gleams of historic civilization, we see the germ of the invention which has done so much to annihilate space and give man illimitable power over all the forces and treasures of nature—a toy in the museum at Alexandria. A toy it remained many centuries, until, in the grand awakening of three centuries ago, its latent power was discovered, and Papin, and Worcester, and Leibnitz, and Huyghens each contributed a thought in the progress which they thus inaugurated. A hundred and fifty years ago the "steam giant" was at work under the direction of the intelligent blacksmith and his comrade, the "tinker," doing much for the mining industry, but nothing elsewhere, and, hampered by ignorance, and ill-cared for by his masters, wasting a vast deal of now utilized power.

Then came forward a genius of the brightest intellect, a mechanic, such as the world rarely produces—James Watt—and, adopting the truly philosophic method, the great master soon taught the mighty servant to do a thousand times more for the world, and to labor with wonderfully greater ease and economy. Watt first collected his facts. He dissected the model of the Newcomen and Calley engine, which had been placed in his hands for repair, ascertained the method of its operation, learned what were the advantages of that form of engine, discovered the cause and extent of its losses of power and efficiency, and, once these were known, his grand intellect promptly devised remedies and improvements, and the steam engine of to-day is simply the steam engine of James Watt, in all its leading features and in all the principal details of design. Its steam-jacketed cylinder is Watt's; its parallel motion and its guides; its crank motion, although an invention usually ascribed to another, were invented by Watt, and the condensing apparatus, the expansion gear, the governor, and even that wonderful little instrument, the "indicator"—the engineer's stethoscope—all came down to us from the same source.

Watt learned the leading facts and made the greatest modifications of plan, while it was reserved for our contemporaries to contribute the refinements of its design and of its manufacture, and to study the more deeply hidden principles of its philosophy, and to determine more definite rules for its construction and management.

Those of you who have been familiar with the design and construction of steam engines during the past twenty or thirty years,† and those of you who have been for a generation past accustomed to handle this miracle of art will remember, as I remember well, how we learned at a very early period in our experience certain cardinal points of practice which were very strongly impressed upon us. We soon learned by experience that efficiency was gained only as we learned to handle higher steam with properly adjusted expansion, to work our engines up to higher piston speeds, to cushion heavily when we had large clearance, to reduce that clearance to a minimum, to adjust the size of our engine to its work, and to determine the point of cut-off, under proper conditions otherwise, by the governor.‡ We learned that the now well-known "American Automatic Cut-off Engine," with its high steam and moderately large expansion, as exemplified by the "Corliss Engine," which is now built all over the world, was the representative of the best general practice.

But we were not satisfied. Twenty years ago we began to understand that we had yet to perfect the phylosophy of the steam engine, and that it was still apparently far from perfect efficiency. We then discovered that while our best engines were consuming from twenty-five to thirty pounds of dry steam per horse power per hour, the mechanical equivalent of the heat supplied in the steam in boiler was sufficient to give about a horse power for each two pounds of high-pressure steam per hour, and hence that we were utilizing but one tenth or one-fifteenth of the heat we were paying for when we settled our coal bills.

Next, we found that, owing to the fact that we can not practically expand down to a pressure lower than that due approximately to the temperature of surrounding bodies, we must therefore discharge heat unutilized, that the larger part of this waste is unavoidable and that an engine, perfect mechanically, and working within the usually practicable maximum limits, must waste three-fourths, and can return useful effect from but one-fourth, of the heat supplied, thus placing the practical limit under known conditions at about eight or ten pounds of steam per hour and per horse power.

And here we stand to-day with the steam engine, mechanically almost perfect, yet with a theoretical economy of about eight or ten pounds of steam per horse

† Reports on Machinery and Manufacturers at Vienna, 1873, by R. H. Thurston, etc., etc., Wash., 1875.

‡ History of the Growth of the Steam Engine; International Series; N. Y., 1878, p. 473.

power per hour, while consuming actually, in the best examples, about fifteen, *i. e.*, with an efficiency of sixty or seventy per cent.

In hot-air engines we are not making much more progress, and our field of promise seems to be still in the improvement of the steam engine.

We are slowly learning other facts. We know that the great obstacle in the way of attaining nearly theoretical efficiency is the transfer of heat from the steam to the exhaust side by initial condensation and re-evaporation; we are discovering that high speed and steam jacketing tend to lose their efficiency at extremely high pressure with wide ranges of expansion, that it seems possible to reach a point in steam-jacketed cylinders at which lower speed may tend to secure efficient working of the steam; that with well-jacketed cylinders we may get good performance, as we to-day judge it, with slow pistons; that we have better work claimed to-day for single than for "compound" engines by ten or fifteen per cent., § the minimum yet reached under fair conditions for economy being stated to be by experiment as 1.54 is to 1.75, while, assuming the very best conditiovs for each, it seems certain that both types should give about equally good results.

Here is where we stand to-day, and it is from this point that we are to work forward. We need to collect more facts by means of carefully-devised experiments like those of Hirn and Hallauer abroad, and of Emery and the Navy Department at home; we need careful and systematic study of the results and finally the determination of the laws of steam engine efficiency as affected by steam pressure and temperature, rates of expansion and compression, character of steam jackets, rate of piston speed, and every other circumstance influencing economy.

ASTRONOMY.

PLANETARY AND STELLAR PHENOMENA FOR DECEMBER, 1880.

BY W. W. ALEXANDER.

Mercury rises on the 1st at 5 h. 44 m. a. m. and on the 31st 6 h. 21 m. a. m. and is at its western elongation on the 21st, at which time it can be best observed, being then in the constellation Scorpius about 7° north of Antares.

Venus sets on the 31st at 6 h. 58 m. p. m. and on the 31st at 8 h. 03 m. p. m., and is fast increasing in size and brilliancy.

Mars rises on the 1st at 6 h. 10 m. a. m. and on the 31st at 5 h. 56 m. a.

§ Abstracts of Papers, No. 1602; Proc. Brit. Inst. C. E., Vols. LIII, LIV. It would seem that where slow piston-speed is demanded, as usually with pumping engines or where two cylinders are needed as with marine engines, the "Compound" engine is unmistakably best; while where high-speed engines are permitted, as in mills, the single-cylinder may still hold its own in this competition.

m. It is in conjunction with Mercury on the morning of the 23d, distance 1° 5′ south.

Jupiter sets on the 1st at 2 h. 03 m. a. m. and on the 31st 00 h. 11 m. a. m. Owing to its increased distance from the earth I omit the phenomena of its moons.

Saturn sets on the 1st at 3 h. 7 m. a. m. and on the 31st at 1 h. 08 m. a. m.

Uranus rises on the 1st 11 h. 51 m. p. m. and on the 31st at 9 h. 5 m. p. m.

Neptune sets on the 1st at 4 h. 47 m. a. m. and on the 31st at 2 h. 46 m. a. m.

The *Moon* will first appear low down in the southwest on the 2d and will be in conjunction with Venus on the 4th; on the 5th and 6th it will be in the constellation Capricornus; on the 7th and 8th it will pass through Aquarius; on the 9th and 10th it will be in Pisces, the present location of Saturn and Jupiter, from thence it will pass through Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, and on the 28th and 29th it will be in Scorpius, the present location of Mercury.

The following is the position of the constellation, on the 15th at 6 h. 30 m p. m. and will nearly be correct for the entire month.

Beginning in the north at the horizon we have Ursa Major, drawing a line from thence up toward the zenith it will cross Draco, Ursa Minor and the eastern edge of Cepheus and then comes Cassiopæa situated in the Milky Way, following which westward we shall cross Cepheus, Cygnus, Lyra, and Aquila, while toward the east Perseus and Auriga. In the south Pegasus the Flying Horse is the most prominent constellation. It is marked by four stars of the second magnitude which form a large square, each side of which is about fourteen degrees.

Andromeda, her hands in chains, lies northeast from the northeast corner of Pegasus in the direction of Perseus, and contains three bright stars nearly in a row.

Cetus, the whale, occupies the south, extending from the meridian to a point three hours east of it.

A very slight declivity suffices to give the running motion to water. Three inches per mile in a smooth, straight channel gives a velocity of about three miles an hour. The Ganges, which gathers the waters of the Himalaya Mountains, the loftiest in the world, is, at 100 miles from its mouth, only 300 feet above the level of the sea, and to fall 300 feet, in its long course, the water requires more than a month. The great river Magdalena, in South America, running for 1,000 miles between two ridges of the Andes, falls only 500 feet in all that distance. Above the distance of 1,000 miles, it is seen descending in rapids and cataracts from the mountains. The gigantic Rio de la Plata has so gentle a descent to the ocean that, in Paraguay, 1,500 miles from its mouth, large ships are seen which have sailed against the current all the way by the force of the wind alone—that is to say, which, on the beautiful inclined plane of the stream, have been gradually lifted by the soft wind, and even against the current, to an elevation greater than our loftiest spires.

EXPLORATION.

LOG OF THE STEAMSHIP "GULNARE" FROM ST. JOHNS, N. F., TO DISCO AND RETURN.

Friday, July 30, 1880.—Fresh breeze from the south. Started the fires, and at 3:30 p. m. took up our anchor and put out to sea. Two of the sailors were missing and two deserted. Gales and thick fog. Distance by log seventy-five and three-quarter miles.

Saturday, July 31st, 1880.—Strong breeze from the south during the first part of the day. Steering east. Thick fog and rain. Fog lifted at 1 p. m.. Saw an iceberg to the east of us. Running under F. G. sail and half steam. Distance by log 253 miles. Course East by N.

Sunday, Aug. 1st.—During the first part of the day light winds from SE. Steering E. SE. Later, wind from the west with rain. Saw a steamer steering SE., also a small iceberg. Lat. 53° 47′ N., Long. 40° 29′ W. Distance by log 204 miles.

Monday, Aug. 2d.—Light wind from the south. Steering NE. by E. All sail set. Distance by log 207 miles.

Tuesday, Aug. 3d.—During the first part of the day strong wind from S. SW. Steering NE. by E. At 4 p. m. furled F. top-sail and G. gallant sail and jibs. Thick fog and rain. At 3 p. m. slowed up and headed the ship to the SE. under close reefed sail. Gale increased and we shipped much water. Distance by log 90 miles.

Wednesday, Aug. 4th.—Heavy gales from S. SW. and the sea running high. At 2:30 p. m. the larboard boat washed away. Threw a part of the deck-load overboard to save the ship. Made a break in the bulwark to let the water off deck; this eased the ship very much. The gale still continued with rain and fog. At 9 p. m. began to moderate. A high sea running, kept off to the NW. running at half speed. At six in the morning saw land, Cape Farewell, about twelve miles distant A large number of icebergs to be seen, occasional fog. Distance by log 74 miles.

Thursday, Aug. 5th.—Fresh breeze from SW. with fog and rain. Steering NW. At five in the evening saw Cape Desolation, distant ten miles. Wind now fresh from W. to W. NW. with light rain. At night strong wind from south and sky overcast. Steering north. Distance by log 180 miles.

Friday, Aug. 6th—Fine weather with fresh breeze from the south. Steering NE. by N. following the coast. All sail set. Saw a few icebergs. Distance by log 180 miles. Lat. 64° 56′ N.

Saturday, Aug. 7th.—A fresh breeze from the NE. during the first part of day. Steering NE. by N. still following the coast. Later, strong wind and thick fog. Distance by log 144 miles.

Sunday, Aug. 8th.—Strong wind from E. NE., fog and light rain. Steering along the land. Saw several icebergs. Distance by log 158 miles.

Monday, Aug. 9th.—Strong wind from the east with fog. At 5:30 p. m. came to anchor in Disco Harbor. Discovered a plank split and broken off under the starboard quarter. The ship's carpenter and one from shore set to work to repair the damages. The crew employed in getting fresh water and in various duties about the ship.

Tuesday, Aug. 10th.—Fine weather. Carpenters at work on the ship, aided by part of the crew.

Wednesday, Aug. 11th.—Weather remains fine. Employed in various jobs about the ship. Carpenters still at work.

Thursday, Aug. 12th.—Fine weather. Carpenters and crew all busy about the ship. During the latter part of the day light rain and fog.

Friday, Aug. 13th.—Fresh wind from the east with light rain and fog. Carpenters at work on the ship. Crew employed in landing lumber, etc. Later, pleasant with light wind from the west.

Saturday, Aug. 14th.—Pleasant, with light wind. Later, a fresh breeze from the SE. with fog. Carpenters at work on the ship, and the crew employed in breaking out and landing lumber.

Sunday, Aug. 15th.—Strong wind from the NE. with rain and fog. At night wind changes to SW.

Monday, Aug. 16th.—During the first part of the day strong wind from the SE. with light rain and fog. Later, the wind shifts to SW. Carpenters still at work. Crew getting rocks on shore for ballast.

Tuesday, Aug. 17th.—Strong wind from the NW., rain and fog. Later, wind still fresh and snowing hard.

Wednesday, Aug. 18th.—Wind from SW., snow, rain and fog. Carpenters and crew still busy.

Thursday, Aug. 19th.—Weather fine and pleasant. All hands employed. Have put on board twenty tons of rock for ballast.

Friday, Aug. 20th.—Weather fine. Carpenters finished work on the ship, and we are ready for the sea.

Friday, Aug. 21st.—Light winds from SW., cloudy. Later, snow and rain. At 9.30 a. m. shipped our anchor and steamed out to sea, bound for Rittenbank. Passed a large number of icebergs. Took a small schooner in tow and a party of ten on board the ship. Light rain squalls at night.

Sunday, Aug. 22d.—Pleasant, with light wind from the west. At 5.30 came to anchor at Rittenbank in thirteen fathoms of water.

Monday, Aug. 23d.—Weather fine. Employed in landing provisions, etc., for Dr. Pavy and Mr. Clay, who are to spend the coming winter here. At night a strong wind from the NW.

Tuesday, Aug. 24th.—Strong wind from the NW. At 6.30 p. m. took up our anchor and steamed out of the harbor for Sakka in search of natives to assist in getting coal. At 11.30 p. m. came to anchor at Sakka in four fathoms of water.

Wednesday, Aug. 25th.—Calm and pleasant during the first part of the day. Later, a strong wind from the N. W. Took a run over to the coal bed but could not land on account of the breakers. Crew employed about the ship.

Thursday, Aug. 26th.—Clear and pleasant with wind from the NW. Took up the anchor and ran over to the coal bed, but again could not land. Strong gales in the straits. Came back to Sakka and anchored in eleven fathoms of water.

Friday, Aug. 27th.—A strong gale blowing from the NW., sky overcast. At 4 a. m. took up our anchor and steamed across to the coal beds. At 7.30 put the second mate with all the crew and thirteen natives ashore, with provisions for two weeks. Capt. Palmer and Lieut. Doane on shore prospecting. Anchored in eleven fathoms of water. A large number of icebergs to be seen. At noon we had taken on board eight tons of coal. Light wind from the SE. at night.

Saturday, Aug. 28th.—Light wind from the SE. and sky overcast. At 3.30 slipped our anchor, as it was impossible to get it clear of the icebergs. Twenty tons of coal on board. Left eight of the crew and twelve natives on shore and steamed back to Sakka. At 11 p. m. cast the lead in seventeen fathoms of water, and at the next cast we were aground on a soft, muddy bottom. At 1 a. m. came off and anchored in seven fathoms of water. Strong wind from the SE. with snow and rain. At 6 a. m. lowered a boat and sounded. Found the bottom muddy and very uneven.

Sunday, Aug. 29th.—During the early part of the day light rain and wind from the SE. At 1 p. m. steamed over to the coal beds. Picked up the anchor we had slipped the day before and went to work getting off coal.

Monday, Aug. 30th.—Weather fine. Employed in getting off coal.

Tuesday, Aug. 31st.—Weather continues fine. Finished coaling, took everything on board, and at 7 p. m. returned to Sakka, where we came to anchor at 11 p. m.

Wednesday, Sept. 1st.—Weather fine. Paid off the natives, 300 pounds of salt beef, and forty pounds of bread. At 10 a. m. took up our anchor and steamed down to Rittenbank.

Thursday, Sept. 2d.—Weather fine. At 2:30 p. m. landed Dr. Pavy and Mr. Clay, with bed and bedding and left for Disco.

Friday, Sept. 3d.—Weather fine with light wind from the SE. Crew employed about the ship. Took on board eight tons of rock for ballast. Carpenters at work on the ship, making repairs, etc.

Saturday, Sept. 4th.—During the first part of the day fresh wind from the SW. and slightly overcast. Later, pleasant with wind from SE. Employed in ballasting the ship, getting water, and various other jobs.

Sunday, Sept. 5th.—Weather cloudy with light wind from the SE. Later in the day, snow and rain with strong wind from the west.

Monday, Sept. 6th.—Fresh wind from the SW. with rain. Crew employed getting aboard water and ballast. Carpenters at work on the ship.

Tuesday, Sept. 7th.—Fresh wind from the NW. with snow. Employed in bringing aboard water and ballast, and scraping spars, etc. Later in the day, light snow and calm.

Wednesday, Sept. 8th.—Clear and pleasant, with light wind from the SW. Busy storing lumber and getting water. At 9 p. m. a Danish barque came to anchor in the harbor. Later, a fresh wind from the NE. and slightly overcast. Finished ballasting the ship, bent the sails, and made ready for sea.

Thursday, Sept. 9th.—During the first part of the day a fresh breeze from the SE. At 3 p. m. took up our anchor and steamed out of the harbor, bound for St. John's, Newfoundland. It was too late in the season to proceed farther north. At 6:30 p. m. called all hands to shorten sail, close-reefed the mainsail and top-sail, banked the fires and hove the ship to with her head to the SW., on the port tack. Gale increasing and a high sea running. Snow and rain. Distance by log 96 miles.

Friday, Sept. 10th—Gale still continues, with snow, hail and rain, and a very high sea. At 10 p. m. clear starlight, barometer still falling. At 1 a. m. began to moderate, and rain commenced falling soon after. At six in the morning started fires and began to run again, steering SW. A little later wind hauled to SW. and we furled all the sails. Light rain and mist, barometer rising. Lat. 67° 56′ N., Long. 58° 30′ W.

Saturday, Sept. 11th.—Light wind from the NW. and a heavy swell from the SE. Steering SW. At 4 p. m. called all hands and shortened sail, and furled all but the fore top-sail. At 8 p. m., weather moderating, saw several large icebergs. At 1 a. m. furled top-sail. Sky slightly overcast with a fresh wind from the west. Steering SW. by S. Distance by log 155 miles.

Sunday, September 12th.—Strong wind from SW., snow and hail and a very high sea. At 6 p. m. banked the fires. At 7 p. m. wind changed to NW., with very heavy squalls. Toward morning the weather moderated, kept off S. SW., set the fore topsail and jibs and began steaming again. Strong wind and snow squalls. Distance run by log, from 5.30 a. m. until noon, 58 miles.

Monday, September 13th.—Strong wind from N. NW. and snow squalls. Steering SW., steam and sail. In the middle of the day, light wind from SW. and mist. Furled all sail. Later, strong wind and a driving snow storm. Distance by log, 144 miles.

Tuesday, September 14th.—During the first part of the day light wind from the SW. with rain. In the afternoon wind changes to SE. At 1 a. m. stopped steaming, being short of coal. At 8 a. m. a strong wind from the west with rain. Steering S. SW. Lat. 60° 6′ N., Long. 56° 36′ W.

Wednesday, September 15th.—Fresh wind from the west during the early part of the day. Steering S. SW. with all sails set. At 2 p. m. strong gales with heavy squalls. Wind W. NW. with a heavy sea; broke the main boom, but rigged it again and set the sails. Steering S. SW. Lat. 58° N., Long. 55° 30′ W.

Thursday, September 16th.—Early in the day a light breeze from the north. Steering S. SW. Middle of the day calm. Later, light wind from the east. All sail set. Lat. 57° 31′ N., Long. 55° 15′ W.

Friday, September 17th.—Weather fair, a light wind from the SE. Ship heading S. SW. At 9 p. m. furled light sails, a little later, close reefed the main sail. Wind blowing heavily. At 12.30 a. m. gale increasing, close reefed the fore-topsail and furled the jib. At four in the morning hove the ship to. A very high sea running and heavy gales.

Saturday, September 18th.—Gale continues with squalls of rain and hail. Moderates in the afternoon. At 4 p. m. set the jib and fore-topsail. Heading S. by W., wind light and a very high sea. At 7 a. m. light wind from the NW. Saw several icebergs. Made all sail, steering south. Lat. 53° 31′ N., Long. 56° 20′ W.

Sunday, September 19th.—Weather fine with a light breeze from the west. All sails set and steering south. Crew employed about the ship. Later in the day, wind from SW., with thin fog. Saw a brig steering SE.

Monday, September 20th.—Calm and cloudy. At 4 p. m. started the fires and began to steam, steering SW. by S. Furled all sail. At 1 a. m. fresh breeze from the NW. and thin fog. Set the jib and fore-topsail. At 3 a. m. a strong gale and a very heavy sea; stopped steaming and banked the fires. At 10 a. m. more moderate. Land in sight, Cape. Lat. 52° 12′ N., Long. 54° 57′ W.

Tuesday, Sept. 21st.—Fresh wind from N. NW. and thin fog. Steering S. SW. All drawing sail set. Saw a barque and brig steering north. At 11.30 p. m. tacked the ship, heading S. SE. Light wind from SW. Lat. 51° 33′ N., Long. 54° 42′ W.

Wednesday, Sept. 22d.—During the first part of the day light wind from the SW. Heading S. SE. Later, strong wind with fog and mist. Reefed mainsail and fore-topsail. Saw a brig heading SE.

Thursday, Sept. 23d.—Strong wind from the SW., with rain. The rain increases. At 3 a. m. light wind from the NW. and fog. Made all sail, steering SSW. Lat. 51° 35′ N., Long. 52° 29′ W.

Friday, Sept. 24th.—Early in the day light wind from WNW., thin fog and rain. Steering S. SW., all sail set. Saw a large iceberg to the north. Island in sight, about eight miles distant. Land ahead on the starboard bow.

Saturday, Sept. 25th.—Strong wind from NW., with squalls of rain and hail. Steaming along the land, all sail set. At 8 p. m. took in sail and half an hour later came to anchor in St. John's Harbor.

Sunday, Sept. 26th.—During the first part of the day strong wind from NW. Later, wind light from the east with rain.

Monday, Sept. 27th.—Wind continues from the east, with rain. Crew setting up rigging, etc.

Tuesday, Sept. 28th.—Strong wind from the south. At 9 a. m. took up our anchor and steamed in to the wharf to get on coal.

Wednesday, Sept. 29th.—Overcast, with fresh breeze from the east. Employed in coaling the ship; hired some hands to assisst.

Thursday, Sept. 30th.—Fresh breeze from the south. At 4 p. m. took a tug and dropped into the stream. Eighty-three tons of coal on board. Three hands came aboard to work their passage to the States. All ready for sea. The day closes with heavy gales and rain.

Friday, Oct. 1st.—The weather cleared early in the morning. The Mail boat arrived at 9.30 a. m. and after getting our mail, took up the anchor and steamed out to sea. One seaman and one fireman deserted. Found a stowaway on board and sent him ashore.

Saturday, Oct. 2d, 1880.—Weather fine and a heavy sea on. At 3 p. m. had to stop to get up steam. Saw several vessels. Later, a fine breeze from the NW. All sails set and steaming. Steering W. SW. Crew employed in washing ship, etc. Lat. 45° 48' N., Long. 54° 40' W.

Sunday, Oct. 3d.—Fine weather, with light wind from NW. Steering W. by S. All drawing sail set and steaming. Saw several sails going east. Coal burning better to-day.

Monday, Oct. 4th.—During the early part of the day a light wind from the east. Steaming W. SW. Later, wind strong from the south. Furled the foretop sail and reefed the main sail. Lat. 44° 7' N., Long. 63° 48' W.

Tuesday, Oct. 5th.—Fresh wind from the SE., which continues all day. Steering S. SW., using steam and sail. Crew employed in washing ship, etc. Saw four sails. Lat. 42° 7' N., Long. 64° 46' W.

Wednesday, Oct. 6th.—During the first part of the day fresh wind from the S. SE., and cloudy. At 1 p. m., changed the course to SW. by S., and made all sail. At 4 p. m., light squalls from the west. Took in and furled all sails. A little later set fore and aft sails. Heavy rain and thick fog. Steering SW. by W. At 10, cleared off and the wind shifted to W. NW., blowing heavily. Lat. 41° 39' N., Long. 68° 50' W.

Thursday, Oct. 7th.—Clear and pleasant, with strong wind from W. NW. Changed the course to S. by E., and made all sail. The compass has carried the ship two points north of her true course. Later, the wind increased, steering SW. by south., fore and aft sails set. At 4 a. m. passed a steamer bearing east. Lat. 35° 35' N., Long. 69° 55' W.

Friday, Oct. 8th.—Weather fine and a strong wind from the W. SW. Steering SW. with all sails set. At 4:30 p. m. wind hauled to west; furled the square sails. Saw several ships going east. At 2 a. m. a light breeze from the NE. Set all sail. Lat. 35° 14' N., Long. 74° 16' W.

Saturday, Oct. 9th —Fine weather, with light breeze from E. NE. Steering S. by W., using steam and sail. At 1 a. m. made Cape Charles Light. Close reefed the sails and headed the ship south. At 5:30 kept off W. SW., and ran for three hours. Saw a barge and schooner, both bound for the bay. Later, strong gales and a heavy sea. At noon Cape Henry in sight, four miles distant.

Sunday, Oct. 10th.—Strong gales from the east, all drawing sail set. Steaming up the bay. At 1:45 p. m. took up a pilot. At 3 p. m. furled all sail, wind strong from the N. NE. Anchored off Smith's point, at 12:30 a. m., and at six took a river pilot and proceeded up the river. Weather pleasant.

Monday, Oct. 11th.—Steaming up the river. At 7:30 p. m. came to anchor at Washington.

IMPORTANT DISCOVERIES IN MEXICO.

M. Charnay, now in Mexico, has written the following letter to the *Trait d' Union:*

TULU, Aug. 28th, 1880.

MR. EDITOR:—Since the telegram which I had the honor to send you on the subject of my discovery, I have succeeded in uncovering a Toltec dwelling, of which I write you. To compare Tulu, capital of the Toltecs, to the Roman city is not simply metaphorical; like her she has been buried long centuries, less numerous, it is true; but the Indian (Mexican) Pompeii, though less ancient, is none the less interesting, for she reveals a world unknown, and brings to science and history documents altogether new. Take notice that I do not claim, in any manner, to have discovered Tulu, but I am happy in having been the first person to make intelligent excavations in it. You will judge of the originality of my labors, when I tell you that this Toltec habitation, exhumed to-day from its burial of ten centuries, is composed of twenty-four apartments, two cisterns, twelve corridors, and fifteen small stairways, being altogether of extraordinary architecture and possessed of intense interest. One thing more important, and which will puzzle all tradition. I have found some bones of gigantic ruminants (of bisons perhaps), the tibias of which are 0.35 (metres) in length and 0.10 in thickness, and a femur, the head of which measures 0.14 in length. This is not all; in the midst of samples of every kind of baked earth, from the largest sort, such as bricks, tiles and gutters, to the smaller kind serving for domestic use, I have found some enamels, some porcelain ware, and something still more remarkable; I have found the glass neck of a bottle, ornamented with the colors of ancient Roman glassware. Are these Asiatic keepsakes, or original products? The question is neither new nor the less worthy of the attention of specialists. We have a surprise on the subject of Toltec industry, or a solution of their origin. I make no commentary, leaving to others the care of destroying the consequences of these important documents. As for me, I work, dig, make collections, and reserve my opinions. * * *

DESIRÈ CHARNAY.

—Translated from *L'Exploration* by J. F.

NORTHERN PACIFIC COAL FIELDS WEST OF THE MISSOURI.

From the best information we can obtain, one of the most extensive coal fields on the globe is located west of Missouri river, and along the line of the Northern Pacific R. R. The first outcropping of this deposit is about twenty-six miles west of Mandan, commonly called the Coal Banks; but, so far as prospected, only a three foot vein has been struck. This vein is a lignite—when first exposed—burning with a clear flame, developing somewhat in combustion the characteristics of cannel and bituminous, but not so good as the Pennsylvania or Ohio coal. This is the quality of all the coal undoubtedly in this whole region of country. Forty miles west of Mandan is the extensive mine of Mr. E. H. Bly, proprietor of the Sheridan House, Bismarck, who prospected a large section of country on the line of the railroad last spring. This mine is a seven foot vein, thirty feet below the level of the railroad grade, and dips about this distance in 400. Over this is a four foot vein, and still another above this corresponding with the level at the Coal Banks of three feet. At Green river, 107 miles west of Mandan, is a monster vein of coal of thirteen feet. Mr. Bly in his explorations discovered numerous veins of coal from three to seven feet in thickness, and claims that anywhere in this great area in the bend of the Missouri, to and including the Bad Lands, on the same level, the same veins may be struck. On the south side of the Missouri river, near Fort Stevenson, a subterranean fire has been burning coal for years. Even the Indians have no knowledge of how long, but by report, extending far back, making there miniature Bad Lands like those west of the Green river, where the fires are extinct. There is no doubt that the so-called Bad Lands were underlaid with extensive layers of coal, and that upon burning out the surface settled down, leaving the peculiar characteristics which constitute their present formation. This is at least the accepted theory with those who have seen the process going on in northern Dakota. The question of coal for fuel, for all ages to come, and at cheap rates too, for the treeless prairies of the Great Northwest is settled—and permanently settled. There is enough for all. Mr. Bly has already contracted to get out 25,000 tons the coming season. These coal lands can be purchased of the Government at $20 per acre, and the Railroad Company will sell at the same price. One thing is certain, that no one man or company can ever monopolize this busines. There is too much of it. There will be coal on every 160 acres for 200 miles west and 200 miles south of the Missouri river—in western Dakota.—*Bismarck Tribune.*

Large quantities of pottery are manufactured in Brazil from the hard, silicious bark of the caraipe tree. In the process, the ashes of the bark are powdered and mixed with the purest clay that can be obtained from the beds of the rivers—this kind being preferred, as it takes up a larger quantity of the ashes, and thus produces a stronger kind of ware.

CORRESPONDENCE.

SCHWATKA'S SLEDGE JOURNEY.

(*Copy furnished by the Author.*)

2 ADDISON GARDENS, KENSINGTON, Nov. 6th, 1880.

MY LORD :—In the brief account of Lieutenant Schwatka's sledge journey to King William's island, by Mr. C. R. Markham, in the November number of the Proceedings of the Geographical Society, my name is mentioned, but in such a manner that I feel entitled to be permitted to offer some explanation.

It is said that "several relics of the Franklin Expedition were bought by Dr. Rae in 1854 from the natives and *sent* home."

What Mr. Markham, with that propensity for unfairness for which he is notorious, is pleased to call "*several relics*," not sent, but brought, home by me, consisted of more than seventy articles, among them twenty-three silver spoons and forks, nine pieces of silver watch cases, one case of a silver-gilt chronometer and dial, two pieces gold watch cases, two pieces gold watch chain, sovereigns, half-crowns, shillings, etc. On some of these articles were the initials or crests of thirteen of the officers (there were sixteen officers in all) and the names of two of the men, "Hickey" and "Fowler."

In addition to these was a cross of the Hanoverian Order of Knighthood, and a small silver plate with Sir John Franklin, K. C. H., engraved upon it.

These relics are deposited in the painted hall at Greenwich Hospital, and taken altogether are, with the exception of the record obtained by the Fox Expedition of 1858–9, equal, at least, in importance to all that has been brought home by subsequent explorers, and were sufficient, in combination with my plain, unvarnished report, to elicit from the Lords of the Admiralty a letter by their Secretary, dated 24th of October, 1854, in which the following paragraph occurs: "I have to request you will inform Dr. Rae of their Lordships' high approval of the services of Dr. Rae, *who has set at rest the unfortunate fate of Sir John Franklin and his party.*" (See letter No. 4, page 834, Arctic blue book 1855.)

As regards the more painful part of the information obtained by me; had any one heard and *seen* as I did, the Eskimos tell what they had to say, they could not, *if impartial*, have failed to believe that they spoke the truth. Had I not reported *all* that was told me, my men would have done so, and *did*, and I might have been justly accused of withholding a part. I found on my return from my fifty-six days' sledge journey, that the three men left in charge at Repulse Bay—none of whom could understand or speak a word of the language—had been already informed by natives, who had been for some time occupied near them, of all the most important sad details by pantomime or dumb show.

I may have added that these strangers, twelve strong men, some of them from the West, had lived on the most friendly terms with my three fellows (who had constantly to be separated one from the other) and had not stolen or attempted to steal a single article, although some guns, boxes of saws, knives, files, daggers, etc., were lying on the rocks, covered and protected by only an oil cloth. Had these Eskimos been so inclined, they could have easily murdered my men, destroyed our boat, and carried all our property away beyond my reach, and left us in a very precarious position, as I was not placed as Hall and Schwatka were, namely, within a few days' journey of a ship, but 700 or 800 miles distant from any assistance. Had they murdered any of Franklin's people, as has been hinted, would they not have done the same to my men, where the temptation must have been very great?

We are given an extract from the writings of Admiral Shevard Osborn, as follows: "We know that the surmises and assertions of savages are false." This may be true of many savages—especially those who have come in contact with civilization—but it is not so with the Eskimos, for my own experience and that of men who have seen much of these people at Labrador, East Main and Churchill lead me to think that it would be unjust, nay, almost an insult, to the poor "Innuit" to class him with the average Englishman for untruthfulness. Were it convenient to do so, I could give some striking illustrations of what I state; yet no further proof seems wanting than the disgraceful disclosures of bribery, falsehood and corruption at present being brought to light in connection with recent elections of certain Members of Parliament, among men from whom something better was to have been expected.

The cravings of hunger become as irrepressibly painful to some men as the irresistible desire for alcohol by the drunkard or for opium by the opium-eater, both of whom know to what misery their excesses must lead, yet they cannot abstain. These failings are certainly a disgrace and reproach to those possessed of them, whereas to have recourse to the most repulsive of food, in a few of many cases of starving men, when the craving amounts to a kind of madness, is assuredly a misfortune, rather than a reproach. Had some of my dearest friends been among the Franklin party, I should have felt bound, in honesty, to tell the story as I told it.

I have myself witnessed this painful craving for food in one or two cases when provisions ran short, and the most objectionable food would have been eaten, although I never had this terrible feeling myself, even when forced to "chew up" pieces of skin and ptarmigan bones up to the beak and down to the toe-nails. It is further stated that one of the officers seen alive was a "*Doctor.*" This is probable enough, but the evidence on which Lieut. Schwatka founds this belief is envious, and possibly not quite reliable. The Eskimos told him that the word Dook-dook was spoken by one of the white men, "an officer," and this was interpreted to mean "Doctor." Now Dook-dook or Took-took is the Eskimo name for "*deer*," and was reported to me, in 1854, to be used in this meaning, when one of the white men, "a chief," was attempting to tell the natives that they were going to the great land to the south to shoot deer—thus: "Took-took-pung—imitating the report of fire-arms and pointing to his gun." This is the note I find in my original journal: Which is the right interpretation, "Doctor" or "Deer?" *

The date of the white man having been seen is given by Lieut. Schwatka as 1849; whereas, the record found by McClintock shows clearly that the date of leaving the ships was April 1848. How Schwatka or anyone else could get a date with any degree of accuracy from the Eskimos after a lapse of thirty years, I am at a loss to understand, and equally so, why these poor suffering men, if alive in 1849, should have remained on King Williams Island or on the main land northwest of Backs River, instead of embarking in their boat or boats and pushing southward on the open water that it is reasonable to suppose must have existed some time during the summer of 1848.

My opinion is that the expectations of these unfortunate men, were vainly founded on the belief that the ice would break up and that the Back River would be navigable much earlier than was really the case; such opinion being formed by them on a knowledge of the breaking up of the ice and navigability of the Coppermine River, 20 degrees further west, which occurs a fortnight or three weeks earlier than at the Republic Bay, or at the Back River. A detention of three weeks would cause, in all likelihood, a fatal and unexpected expenditure of provisions and strength.

Even were it true, as a writer on the *Times* says, that six months or even a years' rations might have been saved out of the three years stock on board—a most unlikely thing—it is very evident that however much provisions were on board, the quantity taken on the sledge journey would be limited to the amount the poor fellows were able to haul or carry, and when that was nearly or wholly expended, they would not be in a very fit condition to go perhaps 140 miles back to the ship for more.

When I was at Republic Bay in 1854, the Eskimos had heard nothing of the ship said to have sank near Point Grant, nor did they know anything of the white men found in 1859, (five years afterward) on King Williams Island by Hobson and McClintock, because the many articles found in the boat would have been removed and the boat broken up, as was afterward done.

The only white men I heard of were the "at least forty" who reached the low, flat shore of the main land, about a long day's sledge journey with dogs, northwest of the mouth of Back River. These men hauled one or two boats with them, were making very short days' marches, pitched tents to sleep in, and were all looking thin, and were probably the last survivors of the ill-fated expedition.

It was from the place where these dead were found that all the relics brought home by me were taken; it was here also where ten or twelve books were seen,

* The Eskimos have a frequent practice of introducing themselves by patting their breasts and telling their names. They may have thought that the white chief was doing the same.

which being for no use, were given to the children to play with and torn up and destroyed.*

The Eskimos (in 1854) said it was curious that although sledges had been seen with the party when traveling, and their tracks on the ice noticed, no sledges were found where the dead men were, although the boat or boats were there. I asked if there were any signs of fire. They replied: Yes. I then explained that as the white men had reached the mainland "Noo Nah" at no great distance from the river they wished to ascend, they did not require the sledges any more, and probably used them for fuel. The explanation seemed satisfactory, as certified by a bright look of intelligence. To us the absence of the sledges would appear of slight importance, but to an Eskimo a large wooden sledge is a grand prize; hence, their absence puzzled them.

I have now to apologize for troubling your lordship with this very long letter, a penalty imposed in consequence of the high position you so worthily hold as President of the Royal Geographical Society. I have the honor to be

Yours respectfully, [Signed.] JOHN RAE.

The President Royal Geographical Society.

Note to the Editor of the KANSAS CITY REVIEW.

Two of the instances of falsehood, (both told with the laudable (?) object of exalting the position of the men and officers of her majesty's navy, at the expense of others who have explored on the Arctic coasts), I think it now *convenient* to add to the foregoing letter. The author of the Northwest passage by McClure, (McClure himself is not responsible) an Admiral in the navy, not long dead, filled a page of the book with a notice of the Arctic work of myself and my Hudson's Bay voyagers, every word of which is false, and willfully so, because this man was informed that his statements were erroneous and proof given to that effect, yet he refused to make a correction in the second edition of the work. Another Admiral who not very long ago was hydrographer to the admiralty and is still living, stated plainly to a very large meeting of our geograpical society, that no Arctic explorers, except those of Her Majesty's service, had ever done any good geographical work!! At the time that this statement was made, five gentlemen, having no connection with the English navy, had received the highest honor that could be bestowed for their Arctic researches—namely:

Thomas Simpson—Founders' Medal 1839, for less *than half* his Arctic work accomplished at that date.

John Rae—Founders' Medal in 1852, who did nearly as much more work afterward. His survey of Wollaston and Victoria Lands were found so much more accurate than the subsequent survey of Captain Collinson, that his survey was not only adopted on the admiralty charts—names and all, but was used to illustrate Collinson's report in the Arctic blue book.

Dr. Kane—Founders' Medal, 1856.

* This story is repeated to Schwatka exactly as it was told to me twenty-five years before.

Dr. Hayes—Patrons' Medal, 1867.

Professor Nordenskjold—Founders' Medal, 1869.

Here we find four of the above five names, obtaining the Founders' or first gold medal for their Arctic work, in precedence of distinguished explorers in other parts of the world.

There can be only one of two conclusions that must be come to; either this Admiral must have said what he knew to be false, or the council of the Royal Geographical Society, probably as just and as competent a tribunal as is to be found in the world, has given its decision unjustly and foolishly to men of whom they had little personal knowledge—for Simpson and Rae had lived half their lives in the wilds of Hudson's Bay, whilst Doctors Kane and Hayes were Americans.

Here are two instances of direct untruths, told with a very paltry and mean object, by men holding the highest position in our navy, yet these very men, forsooth, accuse the Eskimos of falsehood, of surmise and assertion. J. RAE.

THE OLD IN NEW MEXICO.

SANTA FE., N. M., Oct. 10, 1880.

The trip to New Mexico, which, within the memory of very young men, was a three months' toilsome journey from Kansas City, in "prairie schooners" drawn by diminutive mules or broad horned oxen, is now a matter of romance as one glides along over the Atchison, Topeka & Santa Fe Railroad, and gazes out of the windows of his Pullman car upon lovely prairies, well cultivated farms, herds of blooded cattle and sheep, and searches in vain for that *ignis fatuus* of of geographers, the Great American Desert.

Without rehearsing the well known story of the attractions and advantages of Kansas, and the boundless mineral wealth of Colorado, we will at once take up that of New Mexico, which territory, as some writer has aptly said, "is entered through a hole in the ground," meaning the tunnel through the Raton Mountains, at whose mouth runs the boundary line between Colorado and New Mexico. This tunnel is 2,000 feet long, through the hardest of granite, and is a fine specimen of engineering enterprise and success.

From the tunnel we pass swiftly to the plains of New Mexico, and over an almost level road, we descend in clear view of the snow-clad Mexican Cordilleras in the distance, and the nearer foot-hills, often capped in fantastic shapes with pyramids, and cones, and abrupt steeps.

We pass several Mexican hamlets, from which the ever-curious, tawny-faced women and children, dressed in bright colors or in plain black, look out from their abodes in huts upon the passing wonder. And it is indeed a wonder to see a long, full train of cars, with Pullman sleepers, traversing the ancient plains of the Pueblos, the realm of the Montezumas. About noon we cross miles of lava beds, whose black, broken masses cover the ground; and, at a distance to the west, we see the walls of a mighty mountain-crater, with the side open to the east, from which the melted torrent evidently flowed. Ordinarily this plain is covered with a fair growth of a very nutritious bunch-grass, which affords pasturage to vast herds of cattle and sheep, but owing to the total failure of the summer rains, there was no grass crop this year nor vegetation of any other kind. As an example of the truth of the adage that "it never rains but it pours," the rainfall for the month of August, 1880, at Las Vegas, was eighteen inches. All the settled portions of the country are traversed by irrigating ditches, which are now as dry as the plains, but which show the traveler how farming is conducted here in ordinary years. Little patches of wheat and potatoes can be raised, by careful and patient tending, where a sufficient water supply can be had for irrigating purposes, but a farmer of Illinois, Missouri or Kansas can raise a bushel of grain and ship it into the Territory cheaper than a New Mexican farmer can raise the same quantity under the most favorable conditions,. This fact settles the agricultural status of the Territory, and proves that New Mexico, as well as Colorado, must always depend for its bread and provisions upon the great agricultural district embraced within the limits of Illinois, Missouri, Iowa and Kansas. The people of all this vast mineral belt in the Rocky Mountains must inevitably be fed by the great agricultural States of the West.

The mineral resources of New Mexico, however, are practically inexhaustible, and though the Americans have only just begun to invade the Territory, discoveries of gold and silver are reported every day, and in every part of the country. The character of the mineral deposits, in all sections of the Territory, is such as to render considerable capital necessary in order to work the mines with any degree of success.

The towns of New Mexico are curiosities to the American. Las Vegas, for instance, is a place of about 5,000 people—or more properly, two places of about 2,500 each, for it is, in fact, two distinct towns, thoroughly dissimilar in every particular. The "new town" is on the railroad, has broad streets running at right angles, its houses are of frame, generally painted white, and the place has a familiar American look, while the people are all Americans. The "old town," situated about a mile from the road, is different in every aspect, is inhabited by a different kind of people, and looks as though it belonged to an entirely different race and age. Like all the other towns in the Territory, except the three or four that have been put up by the Americans since the railroad came in, it is built around a public square, or plaza; the business of the town is all done on the four sides of the square; narrow streets, or roads, diverge from each corner of the square and lead out into the country, but these, like the cross streets, where there are any, are not more than twenty-five feet wide, are without sidewalks, and are alleys rather than streets. All the houses—business houses as well as residences—are built of adobes—sun dried brick—are one story high, with walls usually about three feet thick, and with flat roofs covered with earth. All the business houses are on the Plaza, while on the alleys or roads leading out from this the residences are situated.

At Las Vegas (the Meadows) we took a carriage for the famous Hot Springs, five miles distant; and, passing directly through the old Mexican city, which still divides with Santa Fe the trade of Northern New Mexico, and which commands the bulk of the enormous wool business, we made our way past several ranch-villages belonging to the old and aristocratic Baca family, to the cool and beautiful cañon in which the springs are located, and were soon domiciled in the excellent hotel there. As these springs are worthy of especial mention, and are not generally known at the East, I will devote some space to their description. The springs are twenty-two in number, and are all found within an area of about ten acres, near the left branch of the Gallinas River, and perhaps half a mile from the mouth of the cañon. They have been, from the time "whence the memory of man runneth not to the contrary," a famous sanitary resort among the Castilian, Mexican, and Indian races inhabiting this region.

These springs rise not far from the mouth of a beautiful cañon, which opens upon the plains four miles above the city of Las Vegas, and from that point winds romantically into the Spanish Range of the Rocky Mountains, the latter extending one hundred and fifty miles southward from the Colorado line into New Mexico. The Springs have an altitude of 6,400 feet—the elevation which has made Colorado such a favorite resort for those affected with pulmonary complaints—with a decided advantage over some of the northern resorts as to latitude and health-giving climate. The character of the waters is similar to that of the famous Hot Springs of Arkansas, as shown by the following chemical analysis, made by Prof. F. V. Hayden, United States Geologist:

Constituents.	Spring No. 1.	No. 2.	No. 3.
Sodium Carbonate	1.72	1.17	5.00
Calcium Carbonate, Magnesium Carbonate,	1.08	10.63	11.43
Sodium Sulphate	14.12	15.43	16.21
Sodium Chloride	27.26	24.37	27.34
Potassium	Trace.	Trace.	Trace.
Lithium	Strong trace.	Strong trace.	Strong trace.
Silicic Acid	1.04	Trace.	2.51
Iodine	Trace.	Trace.	Trace.
Bromine	Trace.	Trace.	Trace.
Temperature	130° F.	123° F.	123° F.

Fifty miles from Las Vegas we come to Baughl's station, where we stop over to explore the ruins of the Pecos church and village (described in the November number of the Review). After spending nearly three days in this interesting work, we again take the train and move on to Santa Fe. The scenery along the whole line, from the Raton tunnel to Santa Fe, with its charming pine-decked valleys and hill sides, its distant purple ranges of mountains and its occasional snow-clad peaks, is very beautiful, while such special objects as the Raton Pass, the Moro Cañon and the Apache Pass are grand and striking.

Santa Fe is about eighteen miles off the main line of the A., T. & S. F. R. R., and is reached by a branch road which has some remarkably steep grades

This old town is probable the oldest in the United States, having been a populous place when the Spaniards found it in 1542. Its citizens claim that it was then known as Cicuyé, but other authorities believe that the old Pecos village was the true site of Cicuyé. Schoolcraft makes no doubt of this, and gives, in his history of the North-American Indians, an engraving of the old church and surroundings under the title of "Cicuyé or Pecos."

The city lies on the edge of a basin of the mountains, and viewed from the summit of a neighboring peak, looks like a vast collection of brick kilns. The houses are mostly of adobe, one-storied, squarely built, and the smoke curling from their tops assists the appearance named. The Santa Fe river—called river by courtesy, for the stream is no wider than you can leap across—flows through its midst.

Its early name was "the city of San Francisco Asis de Santa Fe," Saint Francis being the patron saint. Later it was called "La Ville Real de Santa Fe," which has been reduced to simple Santa Fe, "Holy Faith." Its population now is about 6,000. Its latitude is 35 deg., 41 min., its longitude 106 deg., 10 min., and its altitude 7,000 feet. Its time is one hour, fifty-six minutes and four seconds slower than Washington time.

Among the objects of interest is the Governor's palace, which was erected previous to 1581, from the material of the old town, one story in height and some two hundred feet long, with a piazza along its whole front. It has the appearance of an adobe structure whitened with lime wash. It is nearly two hundred years older than Independence Hall in Philadelphia, and is to this time occupied by the Governor of the Territory. Another attractive object is the San Miguel church, also built of adobes, and more than two hundred and fifty years old. Across the street is the oldest dwelling house in Santa Fe, said to have been built before the visit of Coronado, in 1540. It is of adobe, 60 feet long, 12 high and 15 wide, and is still occupied by several families. The Bishop's Cathedral is now being constructed in modern style, and incloses the old adobe church which will be torn away when the Cathedral is finished.

Guadalupe chapel is another relic of the past, being an adobe building with smooth walls, and surmounted by a diminishing tower formed of mud pillars and containing an antique bell.

Everything about Santa Fe except the railroad and the plaza, which is planted with shade trees and inclosed by a neat fence, is antiquated and foreign.

At Albuquerque we strike the Rio Grande, and along its narrow valley, by means of irrigating canals, the various cereals are raised, as well as apples, peaches and grapes, the last named being of very superior quality.

Near Alamilla station, about fifty miles below Albuquerque, is a Pueblo village consisting of a hundred or more huts. Close by is an immense lava rock profusely decorated with rude drawings of animals, boats, etc., and in a cave near are paintings in black, red and yellow colors representing, among other things, a human figure shooting lightning from his mouth upon the head of another who seems to be prostrated and stunned by it.

The whole region tells of a civilization which was, in its day, far superior to that of the present, and nearly every day new discoveries are made by the hardy prospectors that would delight the archæologist's heart. C.

SCIENTIFIC MISCELLANY.

AMERICA'S RIVER SYSTEM ARTIFICIALLY DEVELOPED.

Has any fanciful person, with a commercial turn of mind, and with a deeper interest in the development of the great trade avenues which nature has marked out than in the highways constructed wholly by human art and mechanism, ever taken the trouble to imagine what the river system of America will be when perfected as it may be, and as it doubtless will be, when the lapse of centuries shall make this the populous country of the world and masterful in art, commerce, and all science?

To map out in fancy all the schemes which must seem not only feasible, but likely to be accomplished as time passes—unless a new motive power be discovered which shall vastly cheapen all present modes of transportation—cannot but seem Quixotic to the ordinary and unfanciful observer, while, in fact, their accomplishment would not embody a tithe of the extraordinary features that have been contained in the modern application of steam, and the utilization of many other recent expositions of science. Probably no fact was ever developed which long anterior to that development did not have its counterpart in fancy, and, therefore, no picture which plain natural law does not declare to be outside of the realms of the possible, should be thought an exaggeration—a mere vision, possessing no phase possible of fulfillment.

If, therefore, any enthusiast be heard to prophecy that the United States—which will then doubtless include all of North America—will one day be traversed by steamships from the Atlantic to the Pacific, and from the lakes of British America, the great lakes, the eastern rivers, and the streams running down the western mountains of the Gulf, he should not be condemned as a fool or a visionary without a close examination of the map of North America, and without indulging in serious speculation as to what engineering, in its wonderful progress, is capable of accomplishing.

Let such an enthusiast have full sway, and he will explain to his audience first how the rivers of the East may be utilized for steam navigation. New England has several rivers which might be improved so that navigation would be extended much farther into the interior than at this time. In New York the Hudson, with its broad expanse, rolls down from the beautiful lakes which lie adjacent to the St. Lawrence, and these in turn have streams flowing into them which could be easily made a connecting link between the river which is the pride of New York and that greater one which carries the waters of our vast inland seas through British territory to the Atlantic Ocean.

Coming to Pennsylvania, we find a vast field for the exercise of that theoretical river improvement which may one day become a fact. The Delaware and Schuylkill could be utilized to a far greater extent than at present, though they could not be transformed into important connecting links with other waters, as some of their sister rivers may be. The Susquehanna offers the most splendid inducements to the theorist. Its head waters lie so near the smaller lakes of New York, which might easily be connected with the great lakes, that any one can see what a grand commercial avenue it could be made. If its own waters, by judicious conservation, should be found insufficient for the use of vessels, an ample supply could be had from the lakes, which would be tapped. Again, the Susquehanna could be wedded to the waters flowing to the Gulf by the route proposed by General Harry White, or by some other way which a survey would discover to be feasible. Any who have traversed the line of the Pennsylvania Railroad will doubtless know how readily the waters of the Juniata and Conebaugh could be united, the former leading to the Susquehanna, and the latter to the Allegheny by way of the Kiskeminitas.

Again, the Allegheny, with its great volume could easily be made a connecting link between the Ohio and the great lakes, first by tapping Chautauqua Lake to mingle with its head waters, and then by uniting Chautauqua with Erie by a canal of eight or ten miles in length. This could be made one of the most magnificent water ways in the country, and would be a great avenue for commerce.

There are several other schemes besides the one mentioned for joining the Atlantic with the Gulf waters. One contemplates a union of the head waters of the Youghiogheny and the Potomac, another the connection of the Monongahela with another branch of the same stream, another a junction of the Kanawha with headers flowing into the Atlantic. All of these schemes look to the grand desideratum of uniting the navigation of the western rivers with that of the Atlantic Ocean. Of course, before this is done, or before such a brilliant intermarriage of rivers could be made to bear fruit, the Ohio, at least, if not the Mississippi, would have to be improved, so that it could be utilized at other times than when the spring freshets, the summer solstice, or the summer equinox, furnish a sufficient supply of water to float a flatboat laden with coal.

Going west to the Mississippi, examination of its northern course shows how readily, in a day of great engineering, that Father of Waters might be connected with the greatest lake in the world, thus completing a grand avenue for commerce between the North Atlantic and the vast agricultural regions of the South and West. West of the Mississippi the powerful mind will not lack for similar food for speculation in tracing the possibilities of uniting the waters of the Missouri, Red, Rio Grande, and other rivers, with those of streams having their origin high up on the Pacific water shed.

Those interested in these matters, and others not immediately or practically interested, may find instruction and diversion in an examination of a map clearly defining the rivers of North America, and estimating the work necessary for uniting them to form a network of avenues for steam navigation extending over the whole country. It is a work for centuries, though, and not for years—we had almost said for eternity, and not for time. Yet we can hardly avoid feeling that this is a part of the America of the future. When the great railway lines are all completed, and there are several of what are, by way of distinction, called "competing lines" between the Atlantic and the Pacific, and between the far North and the far South, and when the railway kings of a half century or a century hence "pool their issues" to fleece the public, then that public, three times as numerous and as wealthy as now, will begin to realize, if not before, that there must be some method of transportation of freight which will check the action of railway companies in imposing onerous tariffs. These modes of transportation will necessitate the employment of either water or air, and as the latter element does not promise richly in this particular, the development of rival methods will doubtless be confined to the water.

The keenly-observant reader may see in all this speculation a satire upon river improvement, and when it is considered how the government temporizes in the matter of river improvement the person who indulges in a fancy so far extended beyond that which is at present a subject for somuch discussion and so little action, may well be accused of attempting a satire. But we believe that the public mind will wake in the near future to the advisability of great improvements in our water ways, and that, as the years now far distant roll by, the increased wealth, population, and energy of America will bring about the perfection of the system for steam navigation which we have fairly outlined, and which now seems a mere figment of the imagination.—*River Record.*

THE SUCCESSOR OF GENERAL MYER.

As yet President Hayes has given no indication of his purpose with regard to the choice of a successor for General Myer as Chief of the Signal Service. It is stated, however, on apparently good authority, that the position is to be given to one of two or three regular army officers, who have never had any connection with the bureau, and who strive for the place as a pleasant and easy berth rather than as a post of great capacity for useful and eminent service. The President will make a great mistake if he allows the Signal Bureau to lose any part of its usefulness, and by putting it in charge of any one whom the newspapers have recently named for it he will do this very thing. He will make it a sort of brevet pension office. The right way to fill the vacancy would be to promote the best of the subordinates of the late General Myer, whoever may prove upon a thorough review of the situation to be entitled to this designation. There are men in this branch of the service who have been there from the beginning—who aided General Myer while he lived and who are entitled to divide with that eminent gentleman all the honors earned by the bureau as a whole. It is idle to say that among these can not be found one who is better qualified than any merely military man can be to fill the vacancy now existing. The Signal Service has done great good in the past and is capable of immensely greater good in the future. To be worthy of its past or hopeful as to its future, however, it must be managed and directed on correct business principles—the very first of which is that the man best fitted for its control shall be intrusted with its control, and that it shall not be treated as a prize to be bestowed upon a personal friend or as a reward for merit, however great, in some department of public service entirely disconnected with its duties.—*St. Louis Globe-Democrat.*

NECROLOGY.

DECEASED 1880.

ANDREWS, PROF. E. B., Lancaster, Ohio. Died Aug. 21, 1880.
ANDREWS, KITTIE GALLUP, Vineland, N. J. Died May 10, 1880.
AUSTIN, C. F., Closter, N. J. Died May 18, 1880.
BARKER, DANIEL, Norfolk, Va. Died Aug. 23, 1879.
BOWERS, MRS. STEPHEN, Santa Barbara, Cal. Died Sept. 1879.
BREWER, THOMAS M., 233 Beacon St., Boston.
BREWSTER, CHAS. G., Boston, Mass. Died 1880.
BUMSTEAD, FREEMAN J., M. D., New York. Died May 28, 1879.
BURBANK, L. S., Woburn, Mass. Died Aug., 1880.
CASSELS, J. L., Western Reserve Coll., Hudson, Ohio.
CHAPMAN, W. B., Cincinnati College, Cincinnati, Ohio. Died 1874.
COOKE, CALEB, Peabody Acad. Sci., Salem, Mass. Died June 5, 1880.
EBERSOL, D. S., Sec. Acad. Nat. Sci., Ottawa, Ill. Died April 10, 1880.
FROST, CHAS. C., Brattleboro, Vt. Died March 16, 1880.
GUNTHER, O. R., Curator Nat. Hist. Soc., Worcester, Mass., Died 1880.
HALDEMAN, DR. S. S., LL. D., Prof. Comp. Philol., Univ. of Pa., Chickies, Pa. Died Sept. 10, 1880.
HUNT, EDWIN, Ph. D., Utica, N. Y. Died 1880.
JOHNSTON, JOHN, Prof. Chem., Wesleyan Univ., Middleton, Conn. Dec., 1879.
KEDZIE, PROF. W. K., Oberlin College, 1880.
LANE, J. HOMER, Coast Survey, Washington, D. C. Died April 24, 1880.
LASSEL, WILLIAMS, F. R. S., Astronomer, died Oct. 4, 1880.
LINDHEIMER, FERDINAND, New Braunfels, Tex. Died Dec., 1879.
MEIGS, PROF. J. H., M. D., Philadelphia, Pa.
MILNER, J. W., Waukegan, Illinois.

MUDGE, BENJ. F., A. M., Manhattan, Riley Co., Kansas. Died Nov. 22, 1879.
MYER, GEN. A. J., Chief Signal Officer, U. S. A. Died April 24, 1880.
PATCH, HARRY H., Salem, Mass. Died Aug. 16, 1880.
POURTALES, L. F., Mus. Comp. Zoöl., Cambridge, Mass. Died July 17, 1880.
SMITH, GREENE, A. M., Peterboro', Madison Co., N. Y.
STAUFFER, JACOB, Lancaster, Pa.
TREADWELL, HOWARD, M. D., Ph. D., New York.
WATSON, PROF. JAMES C., University of Wisconsin, Madison, Wis. Died Nov. 23, 1880.
WELLINGTON, C. W. W., Hyde Park, Mass. Died Aug., 1880.
WOODWORTH, JOHN M., M. D., Washington, D. C.

BENJAMIN PEIRCE: ASTRONOMER, MATHEMATICIAN.

1809–1880.

BY OLIVER WENDELL HOLMES.

For him the Architect of all
Unroofed our planet's starlit hall;
Through voids unknown to worlds unseen
His clearer vision rose serene.

With us on earth he walked by day,
His midnight path how far away!
We knew him not so well who knew
The patient eyes his soul looked through;

For who his untrod realm could share
Of us that breathe this mortal air,
Or camp in that celestial tent
Whose fringes gild our firmament?

How vast the workroom where he brought
The viewless implements of thought!
The wit how subtle, how profound,
That Nature's tangled webs unwound;

That through the clouded matrix saw
The crystal planes of shaping law,
Through these the sovereign skill that planned,—
The Father's care, the Master's hand!

To him the wandering stars revealed
The secrets in their cradle sealed:
The far-off, frozen sphere that swings
Through ether, zoned with lucid rings;

The orb that rolls in dim eclipse
Wide wheeling round its long eclipse,—
His name Urania writes with these
And stamps it on her Pleiades.

We knew him not? Ah, well we knew
The manly soul, so brave, so true,
The cheerful heart that conquered age,
The child-like, silver-bearded sage.

No more his tireless thought explores
The azure sea with golden shores;
Rest, wearied frame! the stars shall keep
A loving watch where thou shalt sleep.

Farewell! the spirit needs must rise,
So long a tenant of the skies,—
Rise to that home all worlds above
Whose sun is God, whose light is love.

Atlantic Monthly, December, 1880.

BOOK NOTICES.

"BULLETIN DE LA SOCIETE DE GEOGRAPHIC D' ANVERS."

We have before us three elegant numbers of the Transactions of the Belgian Geographical Society at Antwerp. This society, though established as recently as October, 1876, seems to be one of the best working institutions of the kind in the world, and scarcely equaled in the long lists of distinguished scientists, who are its active or corresponding members, by any other geographical organization. Among the numerous interesting subjects discussed, we notice Mural Geographical Paintings, Transportation from the Commercial Centers of Equatorial Africa, A Conference with Mr. De Lesseps on the Panama Canal; also, a most attractive article on the Chartography of the Ancients, or the Map-making and Geographical Knowledge of the Ancients. In this article, we find reproduced the rude maps of the Assyrians, Egyptians and Greeks. The pleasure we experience in looking over these transactions leads us to hope we shall be favored with the perusal of the future publications of the Geographical Society of Antwerp.—(J. F.)

BULLETIN OF THE PHILOSOPHICAL SOCIETY OF WASHINGTON, vols. I, II, III. Washington: Government Printing Office.

This society was organized March 13, 1871, and Prof. Joseph Henry wa elected its first president. The objects of the society were stated by him to em brace the study of all those branches of knowledge that relate to the positive facts and laws of the physical and moral universe, and accordingly we find in the proceedings articles and abstracts of articles upon astronomy, physics, chemistry, biology and natural history, contributed by most of the learned scientists of the national capital.

The present officers are: Simon Newcomb, President; J. K. Barnes, J. E. Hilgard, W. B. Taylor and J. C. Welling, Vice-Presidents; Cleveland Abbe, Treasurer; C. E. Dutton and Theo. N. Gill, Secretaries.

THE STUDENTS' GUIDE TO PRACTICAL DRAUGHTING: By T. P. Pemberton. Industrial Publication Co., New York, 1880, pp. 112, 12 mo., $1.00.

This is a small, but thoroughly practical work, by an expert of many years' actual experience, who knows just what beginners need. His directions regarding the necessary instruments and appliances are careful, precise and full, his suggestions practical and valuable, and the whole book will be found eminently useful to machinists, mechanics, apprentices and students.

THE NATURALISTS' DIRECTORY FOR 1880: Edited and published by S. E. Cassino, Boston, 1880: 12 mo., pp. 152, $1.00.

This well-known work is presented this year in an enlarged form, and contains the names, addresses, special departments of study, etc., of more than four thousand naturalists, chemists, physicists, astronomers, etc.; also, lists of the prominent scientific societies, periodicals and books of the United States and Canada, revised and perfected to October, 1880. Mr. Cassino has done this work well, and has made the Directory almost indispensable to naturalists of all classes. Next year he expects to enlarge it, to include, as far as possible, the scientific men and periodicals of the whole world.

MIND AND BODY; THE THEORIES OF THEIR RELATION: By Alex. Bain, LL.D.
THE WONDERS OF THE HEAVENS: By Camille Flammarion. Translated by Mrs. Norman Lockyer.

These two valuable works constitute numbers XIII and XIV of the Humboldt Library, published by J. Fitzgerald & Co., New York. It is unnecessary to speak especially of them, as the authors' names and the titles of the works are sufficient to guarantee them a rapid sale at the low price of fifteen cents each.

QUARTERLY REPORT OF THE KANSAS BOARD OF AGRICULTURE: By Joseph K. Hudson, Secretary, Topeka, Kans. Octavo, pp. 156.

As heretofore, this report contains valuable statistics relative to population, wealth, acreage of crops, condition of farm animals, crops, orchards, meteorological data, etc., together with papers by well-known writers on the breeding, management, feeding and grazing of cattle in Kansas; information on the treatment of milk cows, manufacture of butter and cheese, etc.

No better means of advertising can be adopted by any State than this, and very few men are as well calculated to prepare suitable statistics for the reading immigrant as Major Hudson.

Proceedings oe the Academy of Natural Sciences of Philadelphia, Part I, April to September, 1880: Octavo, pp. 352.

This volume is unusually full of articles based on original work and investigation by the members of this, one of the oldest academies in the United States. Among them we find the well-known names of Professors Leidy, Rand, Lewis, Meehan, Jefferis, Drs. Chapman, Hartman, Allen, etc., etc.

Atti della Societa Toscana di Scienze Naturali, Residente in Pisa.

We have before us the 4th volume of the Transactions of the Tuscan Society for the Natural Sciences of Pisa. It is taken up with the discussion of pure science, or such topics as can only interest specialists. Among the numerous subjects presented, we notice Fossils of the Lower Lias of the Central Appennines; Chemical Study of Heulandite and Stilbite; Action of Heat on the Mixture of Iso-butyrate and Formate of Calcium; New Fossil Teeth of the Notidanus; Histological Study of the Complementary Sexual Organs of some terrestial Mollusks; Oölitic Fossils of Mount Pastello in the Province of Verona; Pliocene Fossils of the Echinodermi, etc., etc. These papers are beautifully illustrated, and as specimens of typography and lithography can scarcely be equaled. The Transactions of this Italian society will be perused with intense interest by all specialists in the study of Natural Science. J. F.

METEOROLOGY.

KANSAS WEATHER SERVICE—STATION, TOPEKA.

OBSERVER, PROF. J. T. LOVEWELL.

The meteorological record herewith submitted is for the month beginning October 20th and ending November 20th. The tables below present the summary by decades, as well as the mean daily average for the whole period of thirty-one days.

It will be noticed that the temperature of the second decade in November is much lower than the two previous decades. The rainfall has been very light, $1\frac{61}{100}$ inches, and no snow, except enough to whiten the ground, on the 16th.

The prevailing winds have been northwest and north. Brilliant solar and lunar halos were seen on the 18th. The barometric readings are reduced to sea level and zero temperature. The highest barometer occurred November 17th, when the record was 30.65. The lowest was 29.70, on the 9th. The highest temperature occurred October 26th, 74°, and the lowest November 18th, 3°.

The self-recording anemometer, from which the wind record is obtained, is exposed to the unobstructed blast as it comes from the prairies and strikes the tower of Washburn College, where the instrument is placed. The velocity of the wind has several times reached 40 miles per hour, and on the 4th was 41 miles part of the day. We have had no gales so violent as occurred in the first part of October, but the total miles traveled by wind has been as great.

	Last 11 days of Oct.	First 10 days of Nov	Second 10 days of Nov.	From Oct 20 to Nov. 20.
TEMPERATURE.				
Min.	32 6	33.4	14.9	27·0
Max.	61.3	54 4	34 1	49.9
Mean.	45.9	43.8	24.8	38.2
Range.	29 9	21.0	19.2	22.4
7 a. m.	35 2	35 1	17.3	29.5
2 p. m.	55.6	49.2	29.1	44.6
9 p. m.	43.1	38.9	18.9	33 6
Mean	44.0	41.5	22 0	35.8
REL. HUMIDITY.				
7 a. m.	.718	.729	.687	.611
2 p. m.	.655	.666	.648	.656
9 p. m.	.698	.683	.679	.687
Mean	.692	.689	.663	.681
PRESSURE, 32° F.				
7 a. m.	30.14	29 94	30 08	30.05
2 p. m.	30.01	29.86	30 24	30.04
9 p. m.	30.01	29.91	30.36	30 09
Mean	30.01	29.90	30.37	30 09
WIND.				
Miles Traveled	3,565	4,127	3,461	11,153
RAINFALL.				
Inches	. . . .	. . . .	. . . .	1.61

EDITORIAL NOTES.

THE October meeting of the Kansas City Academy of Science was largely attended. Dr. Joshua Thorne read a carefully prepared and brilliant essay upon "Intellectual Development," which was followed by an account by Theo. S. Case of an "Excursion to the Birth-place of Montezuma."

The November meeting was also well attended and the audience amply repaid by hearing the third paper of Mr. W. H. Miller upon Herbert Spencer's philosophy, and that of Prof. E. C. Crosby upon the Barometer.

At the December meeting, Col. R. T. Van Horne will read an essay upon the origin of life, under the title of "A New Hypothesis."

THE annual session of the Kansas State Academy of Science was held at Topeka, Kansas, on the 12th, 13th and 14th ult. It was a most interesting and enjoyable meeting in every way, most of the papers read being the results of original investigation, and showing much zeal and research. A full report by Professor J. D. Parker will be found in this number of the *Review*, and it is hoped that most of the papers will be sent us for publication in full.

The Kansas Academy is an honor to the State, and its recommendations should receive the careful attention of the Legislature.

Now that the President of our Academy of Science has been elected to Congress, we may expect that its library will be the recipient of all the valuable publications by the various departments of the Government.

We are promised the monthly summary of the meteorological observations of the Kansas Weather Service by Prof. Lovewell, of Washburn College, Topeka. They will be made up especially for the *Review*, from the 20th of each month to the 20th of the next, so that we can give our readers, almost to the day of going to press, the results just tabulated from simultaneous observations made all over the State. Hitherto, we have received such a summary from both Professor Snow of Kansas, and Professor Nipher of Missouri; also, from Signal Service Observer C. A. Shaw of Wisconsin; but, as they did not reach us until after our day of publication, they had lost their interest to the general reader before the next issue.

Professor Pritchett, of Morrison Observatory, made us a brief call a few days since. He visited Kansas City to complete arrangements for establishing an electric time ball here.

The weather of November was exceptionally cold all over the country, but the reports from Colorado were almost incredible. On the 15th, at Denver, the mercury stood at —15° in the morning, and remained below zero all day; at Leadville it reached —25° on the same day, and at Breckenridge —39°, an almost unheard-of thing, for November, especially. In this city, the lowest point reached was 6° above zero, on the morning of the 21st. This is the coldest November weather remembered here since 1857, when the Missouri was frozen over and navigation closed as early as the 20th. However, it lasted less than two weeks, after which the weather was so moderate that no ice was put up, and most of the time it was like April.

The fall meeting of the National Academy of Science, at New York, was a most successful one. About thirty papers were read by such scientists as Professors Marsh, Langley, Draper, Cope, Gibbs, Agassiz, Barker, Peirce, Rood, etc.

We are indebted to Principal J. W. Dawson for copies of his recent articles on "The Origin of Man" and "Revision of the Land Snails of the Palæozoic Era," published in the *Princeton Review* and *American Journal of Science*, respectively.

The State Agricultural College of Kansas is in a more thriving condition than ever before, owing, as we believe, mainly to the influence and efforts of such able and energetic men as President Fairchild, Professors Failyer and Popenoe, and others, who are widely known as able scientists and liberal minded and progressive teachers.

Major B. S. Henning, well known to all Kansas and Kansas City people, writes from New York to say of the Review that "its success is a great gratification to me, and I want to cheer you on in your good work."

On November 7th, Mr. Powers, of Lexington, Ind., discovered, in a ravine near Eldorado, Kansas, a shoulder blade and tusk of an unknown monster, supposed, however, from the unusual shape of the latter, to belong not to the mastodon, but to the American elephant.

A sharp earthquake was experienced in Panama and in Callao, on the 15th Oct., at 9:25 p. m. The shock was heavy. It lasted about eighteen seconds, commencing with a slight trembling and terminating with a motion which frightened every one. No damage was done.

Sitka advices, via Port Townsend, say that the town was visited by a severe cyclone and a heavy shock of an earthquake October 26th.

Prof. R. H. Thurston, of the Stevens Institute of Technology, says of the Review: "I think the magazine an excellent journal of the class, and admire the manner in which it is conducted."

A letter received from Prof. Richard A. Proctor, the distinguished English astronomer, who is now in Australia, states that he will return to England by way of San Francisco and New York, instead of going via the Indian Ocean, as was his previous intention.

Major J. W. Powell, Chief of the Bureau of Ethnology, has gone to the Pacific Coast to ascertain in person how this work is progressing. He has eight parties in the field, engaged in making a study of the North American Indians—their condition, their habits of life, their languages, their history, etc., as well as taking a census of them. One of Major Powell's parties has just discovered, in New Mexico and Arizona, a number of old ruins and pueblos. These are now being carefully explored. In New Mexico they have discovered, west of Santa Fe, the largest collection of ruins ever found on this continent.

W. H. Simpson, Secretary of the University of Kansas, says: "Our roll now shows 394 students, of whom 15 are from our sister State, Missouri. Never before was the Institution so prosperous and seemingly so thoroughly appreciated by the people generally. We are just beginning to be known and felt."

Mr. H. R. Hilton's able and suggestive paper on The Rainfall in its Relation to Kansas Farming, read before the Kansas Academy of Science last month, is one that should have a wide circulation in those eastern papers that nowadays only publish articles on the arid soil and the famine-stricken people of Western Kansas.

We have had on our exchange list since its commencement that very interesting and valuable scientific journal, the Kansas City Review, and we take this special occasion for urging upon our western readers the propriety of supporting, by their subscription, a journal that embraces so much interesting material, and is so creditable a medium for the exchange of scientific intelligence.—*New Remedies, Nov.* 1880.

We have received a copy of Rowell's Newspaper Directory for 1880, and can conscientiously say that, in our judgment, it is the most complete, correct and comprehensive work of the kind ever published in the United States.

The funeral of the late Prof. J. C. Watson, Astronomer at the Wisconsin University, who died on Nov. 23d, took place at Ann Arbor on the 26th. The will of the deceased astronomer, after providing for his wife and mother, leaves the remainder of his property to the National Academy of Science of the United States. The will further provides that gold medals to the value of one hundred dollars be given to those who shall from time to time make astronomical discoveries, or produce astronomical work worthy of special reward as contributors to science.

Prof. F. V. Hayden, the geologist, has just received a cablegram from the president of the Topographical Society of Paris, announcing that the society had conferred on him the grand medal of honor.

The recent earthquake shocks in British Columbia were very viol nt. Glaciers were split from base to summit, and great masses cast into the valleys and creeks, completely filling them up.

ITEMS FROM THE PERIODICALS.

Subscribers to the Review can obtain any book or periodical published in this country or Great Britain at reduced rates by applying at this office.

The *Popular Scientific Monthly* for December presents the following choice array of valuable matter: The Development of Political Institutions, and Political Organization in General, by Herbert Spencer. Science and Culture, by Prof. T. H. Huxley, F. R. S. Experiments with the "Jumpers" of Maine, by George M. Beard, M. D. The August Meteors, by W. F. Denning. (Illustrated.) The Early Practice of Medicine by Women, by Prof. H. Carrington Bolton, Ph. D. Methods in Industrial Education, by Prof. S. P. Thompson. The Migrations of Fishes, by Dr. Friedrich Heincke. Domestic Motors. I. Wind and Water Power. By Chas. M. Lungren. (Illustrated.) Indigestion as a Cause of Nervous Depression, by T. Lauder Brunton, M. D., F. R. S. Oriental Music, by S. Austen Pearce, Mus. D., Oxon. The Sabbath, I. By Prof. John Tyndall, F. R. S. Sketch of Professor Dumas, by A. W. Hofmann. (With Portrait.) Correspondence. Editor's Table. Literary Notices. Popular Miscellany. Notes.

THE *Journal of the Franklin Institute* completed its one hundred and ninth volume in June, 1880, and is now in the fifty-fifth year of its existence. Under the direction of the Committee on Publication, with its list of able scientists and engineers, as contributors, largely increased, and with the fact that it is the only technological journal published in the United States without any private pecuniary interest, sufficient assurance is given that it will maintain its high position as a leading organ of technology and a standard work of reference. $5 per annum.

THE *American Journal of Science*, now in the twentieth volume of the third series, or the one hundred and twentieth from the commencement, is an acknowledged leader in scientific periodical literature all over the world. The names of its edltors, Professors J. D. and E. S. Dana and B. Silliman, are synonyms among all scholars for the highest erudition in scientific lore and the greatest skill in physical investigation and research, while its associate editors, Professors Asa Gray, Josiah P. Cooke and John Trowbridge, of Cambridge, Professors H. A. Newton and A. E. Verrill, of New Haven, and Professor Geo. F. Barker, of Philadelphia, have no superiors in their respective lines of study and exploration. $6 per annum.

THE *Engineering aud Mining Journal*, edited by Professors Richard P. Rothwell, C. E., M. E. and R. W. Raymond, Ph. D., and published by the Scientific Publishing Company of New York, is now in its thirtieth volume, and has justly earned the reputation of being the most reliable periodical devoted to these subjects in the country.

PROF. S. N. FELLOWS, of the State University of Iowa, has a short and sensible article in the latest issue of the *National Journal of Education*, upon "Didactics *vs.* Pedagogics," in which he proposes to substitute the former word for the latter in college *curricula*, on the ground that it is euphonious, has a respectable origin and expresses better the meaning that is intended to be conveyed by the term. The Professor has our sympathy in his effort to rid the English language of a barbarous, cacophonous and inexpressive word, and the *Journal of Education* should exercise its usual good taste and correct judgment in aiding the effort.

THE *Western Educational Review* for October contains, as usual, many good and appropriate articles, among which we notice two by Kansas City writers, the first upon Prehistoric Man, by Miss Fanny E. Hall, and the other on The Education of the Judgment, by Prof. E. C. Crosby. The *Review* is well conducted and deserves success.

ACCORDING to the *Monthly Weather Review*, published by the Signal Service Bureau, the verification of weather predictions for October amounted to the very creditable and gratifying percentage of 88.9.

THE *Scientific American* of Oct. 13 contains two full page illustrations of Capt. Eads' proposed railway for transporting ships, with their cargo, across continents. Capt. Eads claims, by his plan, to be able to take loaded ships of the largest tonnage from one ocean to the other across the Isthmus of Panama, as readily as can be done by a canal after the Lesseps plan, and at a much less cost for engineering construction. The project is certainly bold and ingenious, and the projector anticipates no serious difficulties in carrying forward his enterprise. The engravings referred to in the *Scientific American* show the proposed construction of not only the railroad, but the appliances for transferring the ships from the water to the rail.

WE have received the prospectus of *The Platonist*, a monthly periodical, devoted chiefly to the dissemination of the platonic philosophy in all its phases. The editor, Thos. M. Johnson, of Osceola, Mo., is a ripe scholar, who has recently published translations of several of the Treatises of Plotinus, and who possesses an eminently philosophic mind. The subscription price of the *Platonist* is $2 per annum.

HOUGHTON, Mifflin & Co. publish, besides the *Atlantic Monthly*, of whose excellence we have spoken so often, *Dwight's Journal of Music*, fortnightly, $2.50; the *Boston* (weekly) *Medical Journal*, now in its one hundred and third volume, $5 per annum; the *United States Postal Guide*, monthly, $1.50 per annum; the *Law Reporter*, weekly, $10, and the *American Architect and Building News*—all first-class magazines, and all of which can be had at reduced rates by subscribers to the REVIEW.

THE *Science Observer*, of Boston, now in its third volume, maintains its high standard of excellence in its special department and bids fair to become the organ of the astronomers of this country.

WE have received the December number, being No. 2, vol. 1, of "*Our Little Ones*," an illustrated magazine for children, published monthly at Boston, by the Russell Publishing Co., at $1.50 per annum. The engravings are unsurpassed, the paper and print first-rate, while the fact that "Oliver Optic" is the editor guarantees uniform excellence in the matter. We shall be disappointed if it does not become a leader among the juvenile periodicals

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THE Santa Domingo Congress has passed a decree that, considering the proofs sufficient that the remains found in the cathedral Sept. 10, 1877, are the remains of Christopher Columbus, a monument to enshrine them shall be erected at the capital. All American governments are solicited to contribute to the fund. The government of Santa Domingo gives $10,000.

HARPER'S MAGAZINE, for December, contains the following good things: Christmas Carillons, Annie Chambers Ketchum, with four illustrations by Fredericks; The English Lakes and their Genil, I., M. D. Conway, with fifteen illustrations by E. A. Abbey and Alfred Parsons; Anne, a novel, Constance Fenimore Woo'son, with an illustration by Reinhardt; Fancy Chances, a poem, Rose Aawthorne Lathrop; The Oldest Institution in the World, W. H. Beard, with an illustration by the Author; The Impatient Bird, a poem, Philip O. Sullivan; The City of Pittsburg, G. F. Muller, with nineteen illustrations by Shirlaw; To be Merry, a poem, Robert Herrick, with an illustration by Abbey; The Sixth Year of Quong See, Catharine Baldwin, with six illustrations; The Lucky Horseshoe, a poem, James T. Fields; Looking Back, a poem, H. R. Hudson; Washington Square, a novel, Henry James, Jr.; Editor's Easy Chair; Editor's Literary Record; Editor's Historical Record; Editor's Drawer.

The *American Naturalist*, for December, announces that it has absorbed the *American Entomologist*, and will hereafter have a department in that line with Prof. C. V. Riley as editor. This addition about completes the "Circle of the Sciences" in its comprehensive range of topics and materially increases the value of the *Naturalist* to its scientific readers. Price $4.00 per annum.

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GEOLOGY AND PALÆONTOLOGY.

THE MASTODON.

BY. PROF. G. C. BROADHEAD.

During the winter of 1879-80, Mr. R. A. Blair, of Sedalia, Mo., has, through his industry and perseverance, his own personal labor and the expenditure of some money, become the possessor, in his own right, of a very fine collection of mastodon remains. They were obtained from a spring at Mr. Wade Mosby's, seven miles southeast of Sedalia. About fifteen years ago Mr. M., in placing a "gum," or section of a hollow log, in his spring, found a few large bones and the fragments of a tusk. But until the fall of 1879 no examinations or searchings for bones were made. At that time Mr. R. A. Blair, becoming interested in the matter, began to work in earnest, and the result was the finding of the large collection now in his possession.

The surface of the ground at the spring, where the bones were obtained, is about fifteen feet above the creek, which is about four hundred feet distant. The upper spring is about five feet higher than the other spring and ninety feet distant. They lie about two hundred feet from the base of the hill, just back which rises up by gentle slopes. Mr. Blair dug a ditch from the spring toward the creek, passing through alluvial loam to a bed of gravel, which seems to lie nearly level and to pass beneath the spring, or six to eight feet from the surface, approaching the surface toward the creek. The gravel was not passed through. Blue clay rested upon the gravel. The diameter of the spring and bog seemed to be about twenty feet. It may originally have been a little larger. The material within this diameter was a light spongy, peaty humus, containing the mastodon bones and pieces of wood resembling cypress. A fine gray sand occurred at the bottom and bright blue sand would boil up toward the top. Only in this funnel-shaped space of fifteen feet in diameter at top were found the mastodon remains, occurring from three to eight feet in depth and including fragments of both large and small individuals, and in number about eight skeletons. Perfect heads, with the teeth attached, were obtained. The tusks were much broken. Other bones, both of the leg and ribs, were obtained, and also vertebræ. The largest tusks indicated about seven feet length, the hollow portions of which were filled with black clay. Some of the older teeth were nearly entire, while those of younger individuals were much worn. Some jaws show young teeth in front of old ones, as if shedding and replacing others. The jaws had from two to four teeth on a side, some 2 inches square to 4½x8. A jaw with only two teeth has one of them 4x8 inches, the other 4x3½ inches. The largest tusk observed was about five inches in diameter at large end, the whole gently curved. A few flint implements (spear heads) and one stone club were found with the bones.

Mr. Blair has preserved the remains, and placed them in cases so they can be well seen. His is the *Mastodon Americanus cuvier.*

Dr. Albert Koch was the first person who made explorations by digging for mastodon remains in Missouri. In 1839 he exhumed certain bones from a spring on the Bourbeuse river, in Gasconade county, Missouri. Dr. K. thought these bones had been partially burned; this, however, has been disbelieved by others, so it remains in doubt. Arrow heads of flint, and stone axes, were also found. In the material at the bottom, which Dr. K. considered ashes, there was much gravel, above this was eight feet of clay and sand, from which flowed the spring and in which lay the bones.

About 1840 Dr. Koch dug out the bones of another mastodon, in the valley of Pomme de Terre river, ten miles southwest of Warsaw. Dr. K. states that an arrow head was here found beneath the thigh bone of the animal. With them was also found fragments of wood and roots, with logs and cones of the cypress, together with flint implements. The bones were overlaid by distinct layers of clay, sand and gravel, to the thickness of twenty feet, which sustained above a growth of old trees.

Lay, in his history of Benton county, speaks of these bones and states that they have been found in two places in the county; one on the farm of the heirs of Charles Wickliffe, on the Osage, the other near the farm of Alexander Brashears, on the Big Pomme de Terre. From the Wickliffe farm nearly a whole skeleton was taken to Cincinnati, of which a tusk was said to be nine feet long. Other bones were also obtained at the same place.

The Messrs. Bradley, of Boone county, kept fifteen or twenty hands at work for several months on the Brashears place, and took out a great many bones. But they were so much decomposed, that after exposure they fell to pieces, and the men lost money by the venture.

Dr. Koch states that, at one time, he had six hundred teeth of mastodon, all found in Missouri, and nearly an entire skeleton was obtained from Benton county, which was afterward sold to the British museum. This he called the "Missourium." It is the *Mastodon Americanus* (*giganteus*). Its extreme length was 20 feet 2 inches; height, 9 feet 6¾ inches; length of cranium, 3½ feet; its vertical dimensions 4 feet, width 2 feet 11 inches; width of pelvis, 5 feet 8 inches; extreme length of tusks 7 feet 2 inches, projection of same 5 feet 2 inches, circumference at base, 27 inches.

On the Osage and its tributaries are extensive deposits of clay resting on sand and gravel; at the bottom of the clay there are occasionally found remains of extinct mammalia, the mastodon, horse, ox, etc. On the Marais des Cygnes, at Papinville, we find these beds as follows, counting from top:

1.—30 feet 10 inches yellow clay;

2.—4 inches blue clay and gravel;

3.—5 feet sand and gravel, the latter sometimes partially cemented together.

At Burnett's ferry, Bates county, we find—

1.—10 feet sandy clay;

2.—10 feet blue clay with pebbles.

In the gravel beds at Papinville, a tooth of an extinct species of horse was found, together with fresh water shells. On the river bluff near by, a mastodon tusk 7 feet 4 inches long was found in the gravel.

Mr. H. H. West discovered, in the Loess of Kansas City, a portion of the tusk of a mastodon, an account of which he published in the REVIEW. This may have drifted from deposits a little older, or more probably washed into the Loess lake from the adjacent shore.

Mr. J. C. Evans obtained a large tooth of a mastodon from Line creek, Platte county. This was probably washed out from the later glacial clay.

A mastodon tooth has also been obtained in Caldwell county.

The Kansas City REVIEW for March, 1880, gives an account by Dr. Ballard of the discovery of mastodon remains in the Eastern part of Jackson county. Dr. B. gives the size of tusk as 14 inches in diameter(!)—from imprint in clay—and 12 feet long. This is of greater dimensions than any I have ever seen or heard of before.

The above are notices of such remains that I know of having been found in Missouri. We will now speak of mastodon remains in other states.

In the REVIEW for September, 1877, is a brief notice of remains on Bijou creek, in Colorado. Only leg bones were obtained, but were of large dimensions, measuring 29½ inches in circumference at upper end.

Remains have been found at several places in Kansas, chiefly in valley of Marais des Cygnes, some in Miami county, and some in Franklin county. Other bones have been found near Emporia.

Prof. Woodman exhumed a mastodon at Melton, Iowa, twenty-five miles west of Davenport, from the bank of a stream, in an excellent state of preservation. It indicated a height of fourteen feet.

The Wheaton mastodon, found in Du Page county, Illinois, was obtained four feet below the surface in a boggy place. It was probably 14 feet in height and 20 feet long.

From Big Bone Lick, Boone county, Ky., it is said that fragments of one hundred skeletons of the mastodon have been exhumed. It is a fact connected with the occurrence of these bones, as well as those found on the Osage and in all boggy places, that they seem as if the animals had come there to drink or lick, and had stuck in the mud so as to be unable to extricate themselves. To this fact science is indebted for the excellent state of preservation in which the remains occur.

In various parts of North America we find marshy tracts abounding in salt or brackish waters, which, during the present generation, are much resorted to by the deer and other animals. These places are called "licks," and are found at many places in Missouri.

The Big Bone Lick, Kentucky, is traversed by a small stream of brackish water. Its bottom consists of black, fetid mud, intermingled with sand and traces of vegetable matter. In this bog, bones of great magnitude have been found in great numbers. Mantell informs us that a fine skull with teeth, from the Big Bone Lick, had been placed in the British museum at a cost of 150 guineas. The length of the skull is 36 inches.

Mastodon bones have been found in several other portions of Kentucky, some in Henry, and also in Owen county. Skeletons of the great Mastodon have also been found in bogs in Louisiana, in a vertical position, as if they had sunk in the mire; and one found in New Jersey, forty miles south of New York, was found in black earth, in the same position, as if it had sunk in the mire. The remains of the *Mastodon Americanus* have been found at several other localities n the more recent bog and lacustrine deposits of New Jersey. The most remarkable of these were found on the farm of William Ayers, half way between Vienna and Hackettstown, in Warren county. Six skeletons were found in this bog, and they were covered by six feet of mud. A small pond now occupies the place of this bog. Lyell informs us that five skeletons were lying together, and that many of the bones crumbled very much upon exposure. But nearly the whole of the other skeleton, which lay ten feet apart from the rest, was preserved entire, and had twenty ribs, like the elephant. From the clay in the interior, or where the contents of the stomach should be, seven bushels of vegetable matter were extracted. A microscopic examination showed it to consist of pieces of small twigs of a coniferous tree, of the cypress family, probably the shoots of *Thuja occidentalis* (Am. *arbor vitæ*).

Another tooth was also found half a mile northeast of this; also in same county, on farm of Charles Howell, an imperfect skeleton. These remains were probably taken to New York. Other remains were obtained near Greensville, Sussex county; also at three places in Monmouth county, and a portion of a jaw in a mill-race near Marlbro, at Hartshorn's mill, and near Freehold, and a very perfect tooth near Verona, Essex county.

Bones of the Mastodon have been found at numerous places in the State of New York, especially in the western part. We quote from the New York Geological Reports: "In the bank of a stream, in gravel and sand, near the town of Perrinton, and now in the Rochester Museum.

"In 1838, during the excavation of the Genesee Valley canal in the city of Rochester, a tusk, some bones of the head, several ribs and other bones were found, intermingled with gravel and sand, and covered by clay and loam, and above these a deposit of shell marl. The tusk was nine feet long.

"During the excavation of the Erie canal, a large molar tooth was found in a swamp near Holley, Orleans county.

"In the fine gravel and loam, containing fresh water shells, and evidently a fluviatile deposit, at Niagara Falls, a molar tooth was found.

"In a muck swamp in Stafford, Genesee county, a small molar tooth was found. In 1841, a molar tooth, weighing two pounds, was found in a bed of marl three miles south of Leroy. At Geneseo, in Livingston county, a large number of bones and several teeth were found in a swamp, beneath a deposit of muck, intermingled with a sandy, calcareous marl.

"At Hinsdale, Cattaraugus county, a tusk, with some horns of deer, were found, sixteen feet below the surface, in gravel and sand.

"At Jamestown, Chautauqua county, a tooth of a Mastodon was found, several feet beneath the surface, in gravel.

"In speaking of the occurrence of these bones, Prof. James Hall says that these bones often occur imbedded in gravel and sand of the nature of the ordinary drift; but, in such instances, it can usually be shown that they have been transported and the deposit in which they occur is one of very modern origin.*

The marl beds and muck swamps rest upon the drift. The gravel beds occurring with the bones are evidently of transported drift.

"The earliest records that we have of the bones of the Mastodon is a letter from Cotton or Increase Mather to the Royal Society of London, between 1650 and 1700, describing the bones of one of these animals found near Albany.†

"The bones of the Mastodon are frequently found in the peat bogs of Orange and Ulster counties. Bones of Mastodon were found in 1790–'91, and in 1800, in the town of Montgomery, twelve miles from Newburgh, Orange county. They were ten feet below the surface, in a peat bog. One of the leg bones measured more than forty inches around the joint, and thirty-six on the cylindrical part of the bone, and nearly five feet long; the teeth, nearly seven inches long and four broad, were found white, fast in the jaw, and with no appearance of decay. The orifice in the back bone, where the marrow was, was three and a half inches in diameter. Eight similar skeletons have been discovered within eight or ten miles of this, some of them fifteen to twenty feet below the surface. A Mastodon, exhumed at Newburgh in 1845, indicated the following dimensions: Height, 11 feet; length to base of tail, 17 feet; tusks, 12 feet long—2½ feet

* Nat. His. N. Y., part 4, Geology, 4th Dis. p. 365.

† Ibid. Geology, 1st Dist., p. 47.

inserted in sockets. When alive, it must have been twelve or thirteen feet high, and length, including seven feet for tusks, twenty-five feet.* It was found in peat, with a thin layer of fresh water marl above it.

Prof. H. A. Ward, of Rochester, N. Y., has in his museum twenty-seven casts of Mastodon, embracing nine species, of which *M. Arvernensis*, of Europe, and *M. Americanus*, of America, are from the Pleistocene or Quaternary. *M. borsoni*, *M. affinis*, *M. dissimilis*, *M. insignis*, are from Pliocene, of France. *M. longirostris*, from Miocene of France. *M. elephantoides*, *M. andium*, from Miocene of India.

In the twenty-first annual report of the Board of Regents of the New York University, Prof. James Hall furnishes an interesting account of the discovery of the bones of *Mastodon giganteus* (*M. Americanus*) at Cohoes, in the valley of the Mohawk river, State of New York, in September, 1866.

The bones werc found in a pot-hole, which was sounded and found to be over sixty feet in depth, filled with clay and soil on top, and peaty clay, with branches and trunks of trees below. The lower jaw was found about twenty-five feet from the surface; the other bones below. This "pot-hole" showed that, previous to the deposition of the mastodon remains and the subsequent filling up of the "hole," powerful agencies had been at work. Subsequent explorations revealed portions of the skeleton sixty feet distant and 20 feet higher than the bones in the pot-hole, but by comparison it proved to be part of the same skeleton. Prof. Hall reasons that the mastodon had floated down the Mohawk when its bed was more than one hundred feet above its present level, and lodging upon its rocks had gradually become dismembered and its parts transported to different points, and there deposited upon the disintegration and melting away of the glacier.

It would further appear that, during the glacial period, the surface water, falling through the crevices in the vast ice mass, had eroded deep cavities in the rocks below. Into these, fragments of rocks fell, and, being continually acted upon by the water for a long time, kept the fragments in motion, wearing around the incipient pot-hole. Toward the close of the glacial period, a mastodon which had become frozen into the ice mass, became disengaged and fell into these holes.

A few measurements of the Cohoes Mastodon are as follows:

Circumference of tusk	18¼ inches
Length "	4 ft. 9 in.
Length first rib	2 feet
Circumference of rib at Middle	6¼ in.
Length of Ulna	2½ ft.
" Radius	2 ft. 3 in.
" Femur	3 ft. 5½ in.
" Tibia	2 ft. 2 in.
" Fibula	22½ in.

* Dana, p, 567.

The Warren skeleton (from near Newburgh) is of maximum size, suppo ing unusually long and large tusks, armed with inferior canine teeth and exhibi. ıg a small pelvic aperture; is undoubtedly a male. The Cambridge Mastodon is much smaller, though nearly as old, with short and slender tusks above and none below, and a large pelvic aperture; is a female. The Cohoes skeleton, of the same age of the Cambridge, has a comparative small pelvic aperture, proving it to be a male.

A few bones of the Mastodon have been found near New Britain and Cheshire, Connecticut.

Mastodon teeth were found at Pittstown, Luzerne county, Pa., associated with teeth of *Equus major* and *Bison latifrons.*

A tooth of a Mastodon found in Quaternary, of Niagara, indicates that six miles of the gorge have been excavated since he existed. (Dana, p. 510.)

Four grinders of a Mastodon—one sixteen inches in circumference—were found in Kishaco, Quillas Valley, Pennsylvainia, resting upon rounded pebbles and covered with a few feet of alluvium.

Prof. H. D. Rogers informs us that the pleistocene beds of shelly sands cover a broad belt of country on the Atlantic coast of Virginia and North Carolina as far as Pamlico sound. These beds contain many shells identical with species now occurring on the Atlantic coast and one or two now only living in the warmer waters of the Gulf of Mexico. Mixed with these shells are the bones and teeth of several extinct land quadrupeds, including the fossil elephant and the *Mastodon giganteus* and a large species of extinct horse.

Prof. Emmons informs us that the bones of the Mastodon are not uncommon in the miocene marl of North Carolina and instances localities in Halifax county, in a marl pit in Nash, upon the Cape Fear, and at other places.

Prof. Kerr informs us that the whole eastern portion of North Carolina, a tract extending more than a hundred miles from the coast and rising 500 feet above the sea along its western margin, is covered chiefly with a deposit of shingle, gravel, sand and clay, the coarser to the west, the finer near the coast. This covers nearly the whole of the Tertiary and Cretaceous, a considerable part of the Triassic and part of the Archæan. The eastern band of this, rising to 100 feet elevation above tide, is assigned to the *Glacial period* or early Quaternary, consisting in the lower part especially, of coarse pebbles associated with fossils in the form of sharks' teeth, coprolites and bones, and here have been found the best preserved Mastodon teeth and bones. Prof. Hilgard, maintaining the occurrence of Mastodon bones in the Loess of Mississippi, says they are generally found singly, but that portions of the skeleton have been found in spots where ponds existed, as though the animal had perished there. In such places the bones are frequently in contact with masses of black fatty earth, probably decomposed animal matter.

In Martin county, Indiana, bones of the Mammoth and the Mastodon have been found in marsh clay, resting on the drift. In Michigan, according to Winchell, in accumulations öf marl and peat are found the remains of the elephant, Mastodon and elk. A fragment of the molar of a Mastodon was found at Green Oak, Livingston county. Mr. Shattuck has exhumed nearly an entire set of Mastodon teeth, including a piece of a tusk in Plymouth, Wayne county. The teeth are all perfect and still retaining their glossy enamel and most of the fangs pertaining to molar teeth.

A nearly perfect skeleton of a Mastodon was exhumed near Bucyrus in Crawford county, Ohio, many years ago from the muck and marl of a swamp, and is now in possession of the Ohio Agricultural and Mechanical College. The "Erie clay" is the lower drift near the lakes, and is sometimes as much as 280 feet thick. Above it lies the "Delta sand," separated about Cleveland from the Erie clay by one to two feet of carbonaceous matter with trunks of trees. This "forest bed," as it is called by Prof. Newberry, extends through a large part of Ohio and into many other of the Western states; traces of it exist in Illinois, Missouri and Nebraska. Prof. Newberry informs us that the Delta sand deposit near Cleveland has yielded numerous portions of the skeleton of the elephant and Mastodon. In other parts of Ohio they are found in the forest bed, and in the overlying drift and in the recent peat marshes.

Remains of the Mastodon are found in the post glacial beds of the Maumee valley. Part of a skeleton was obtained from a peat swamp near St. Johns, Auglaize county, The appearances indicate that the animal had mired and died where found. Prof. Gilbert carefully examined the locality and was confirmed in this opinion; also that the animal lived and died after the deposition of the drift, and that the overlying peat had since been formed. The depth of the swamp is eight feet, of which the upper one-third is peat.

Passing to the Pacific slope, Whitney informs us of the occurrence near Benicia, California, of a Post-Tertiary deposit made up of beds of gravel, sand, clay and oyster shells, and containing fragments of bones of large animals and rolled Tertiary shells. At Bottle Hill, near Benicia, these beds contain boulders of gray sandstone, also bones of the Mastodon and horse. In the Gaviota pass, in the superficial detritus at the bottom of a layer of clay four feet thick and resting on sand, were found Mastodon bones. In Tuolumne county, on the southern bank of the Stanislaus, there is a vast accumulation of calcareous tufa which assumes a most picturesque appearance, sometimes rising in cliffs like coral reefs. In this deposit are found many fragments of mammalian bones, including the Mastodon, Elephant and horse; also both land and fresh water shells All through the region northwest of Columbia, as far as Abby's ferry, the remains of the elephant and Mastodon are very abundant.

Quoting from Whitney's Geology of California, he says: Among the animals of the Pliocene we recognize the rhinoceros, a species of horse, an animal resembling the camel and one resembling the hippopotamus, and they are peculiar to the deposits under the lava. The lava flow destroyed them. After that was the Post Pliocene epoch appearing on the foot hills and slopes of the Sierra. This passes gradually into that of the present day, or the recent. Prominent among the animals of that time were the Mastodon and elephant, whose remains are found in the detritus of the gold region. Associated with them were the tapir, the bison and the horse—two species—one of them scarcely distinguishable from the present mustang.

From the Tertiary of North America Prof. Leidy names three species, including the South American species *Mastodon andium*, also found in Central America, *M. mirificus* in the Pliocene of the Loup fork of Nebraska.

The *M. obscurus* was first noticed from the Miocene of Maryland.

Dr. Lorenzo G. Yates, of Centreville, Cal., has discovered a number of Mastodons in California which are referred to this species, notably the lower jaw and upper molar at Oak Springs, Contra Costa county, Cal., in the Pliocene Tertiary; the fragment of a tusk from Stanislaus county.

Remains of this species from near Santa Fe, New Mexico, are found associated with *Elephas americanus*, the cancellated structure of the bones filled with crystalline Calcite. The *M. mirificus* has been obtained from Sinker creek, Idaho, and the Niobrara, Nebraska.

Von Meyer describes the jaw of a Mastodon from Michvasan, Mexico, as M. *humboldtii*, but Prof. Leidy thinks this must be *M. obscurus*. We thus find that the Mastodon first appeared in America in Miocene times; was abundant in the Pliocene, and lingered until the close of the Glacial period and disappeared in the early Loess. We also find that he roamed at will, from Canada to South America, being found as far North as 66° N. Lat. on our Western coast; and either entire skeletons or portions have been found in nearly every State and in some of the Territories. The *M. arvernensis* has been found in the Pliocene of England, (Red Crag,) associated with the *Hippopotamus major*; in Val d'Arno, in Piedmont and Montpelier. The M. *angustidens* is from the Miocene of Lonans, of Touraine, and from Gers, near the base of the Pyrenees, associated with *Dinotherium*. Mastodons have been found in the Miocene of Switzerland, of Greece and *M. longirostris* is found at Vienna, associated with *Dinotherium*, *Rhinoceros*, etc.

Humboldt discovered the tooth of a Mastodon near the volcano of Imbaburra, at an elevation of 7200 feet. Mantell informs us that the Turquois of Simone are composed of mammoth bones, impregnated with a metallic oxide.

A species named *M. elephantoides* was obtained by Mr. Cranford from the banks of the Irrawaddi in the Birman Empire. The bones were here invested with a hard calcareo-silicious conglomerate.

In the foot-hills of the Himalayas the bones of a Mastodon are found associated with those of seven species of the elephant, four of hippopotamus, five species of rhinoceros, three of horse, elk, camel, giraffe, sheep and the wonderful Sivatherium. There is also here found an ostrich, an ox and a tortoise with a shell twelve feet in length. The Sewalik hills where these are found, rise 2000 to 3000 feet above the sea, and contain the most remarkable deposits of Miocene animals in the world. The *Elephas Ganesi* here found have tusks ten and a half feet long, and twenty-six inches in circumference at the base.

A species of Mastodon, related to *M. augustidens* has left its remains in the ossiferous caves of Australia and probably the same species has been found in Peru.

Nicholson's Paleontology pp. 442 gives order *Proboscidea* including three genera *Elephas*, *Dinotherium* and *Mastodon*, characterized by total absence of canine teeth, few molar teeth, large and transversely ribbed or tuberculate; incisors always present and grow from persistent pulps, constituting long tusks. In all the elephants there are two of these tusks like incisors in the upper jaw, the lower jaw without incisor teeth. In the *Dinotherium* this is reversed, being two tusk-like lower incisors and no upper incisors. In the *Mastodon* the incisors are usually developed in the upper jaw and form tusks as in the elephant; but sometimes there are upper and lower incisors movable in every direction, highly sensitive and terminating in a finger-like prehensile lobe. The nostrils are placed at the extremity of the proboscis. The feet are furnished with five toes each, but these are only partly indicated externally by the divisions of the hoof. The feet are furnished with a thick pad or integument, forming the palms of the hand and the soles of the feet. There are no clavicles and the tusks are abdominal through life. There are two teats, and these are placed upon the chest.

In the elephant whether living or extinct, the tusks are formed by an enormous development of upper incisors. The milk-tusks are early shed and never attain a great size. The permanent teeth, however, grow from persistent pulps attaining an enormous size in old males. The lower incisors are absent and there are no other teeth in the jaws except the large molars, which are usually two in number, on each side of the jaw. The molar teeth are of very large size and are composed of a number of transverse plates of enamel, united by dentine. The surfaces of the molars are approximately flat. There are six species of *Elephas* in the Miocene of Asia. The *Elephas antiquus* is a southern form of Pliocene age. The *Elephas primigenius* is a northern form of Post-pliocene age, and is the hairy mammoth occurring in Siberia in Northern Europe and the northern portion of North America. It did not occur, (according to Dawkins,) South of a line passing through the Pyrenees, the Alps, northern shores of the Caspian, Lake Baikal and Kamschatka. It survived the Glacial period and is found abundantly in Post-glacial deposits of France, Germany, Britain, Russia in Europe, Asia and North America. It survived into the earlier portion of the human period, its remains being found in a great number of instances associated with implements of human manufacture; while in one instance a recognizable portrait of it has been discovered, carved on bone.

The *Elephas Malitensis* of Malta was scarcely four and a half feet high; another the *E. falconeri* was still smaller, being two and a half to three feet.

But little was known of the *Dinotherium*, only found in the Miocene. Its skull was enormous, the molars and pre-molars were present in each jaw, the upper jaw destitute of canine and incisors. In the lower jaw were two long tusk-like incisors bent downward like hooks.

The Mastodons in most respects closely resemble the true elephants, from which they are distinguished by their dentition. As in the elephants the upper incisors grow from prominent pulps and constitute long tusks; but in the majority of cases the Mastodons also possess lower incisors as well. The lower incisors, however, though tusk-shaped, did not develop themselves to any extent, and often disappeared in adult life. A more important distinction between the elephants and Mastodons is, that the molar teeth of the latter are not only more numerous, but have the peculiarity that their crowns are furnished with nipple-shaped eminences or tubercles placed in pairs, (its name derived from the Greek *Mastos*, a teat, and *odous* a tooth).

In the Mastodon the dentine or principal substance of the tooth is covered by a very thick coat of dense and brittle enamel, a thin coat of cement is continued from the fangs upon the crown of the tooth, but this third substance does not fill up the inter-spaces of the division of the crown as in the elephant's grinder.

In the *M. ohioticus* (*M. americanus*) the lower jaw has two tusks in the young of both sexes; these are soon shed in the female, but one of them is retained in the male. The upper tusks are long and retained in both sexes. The Mastodons were elephants with the grinding teeth less complex in structure and adapted for bruising tender and coarser vegetable substances, roots and aquatic plants. The large eminences of the grinding teeth, the unusual thickness of the enamel and almost entire absence of the softer cement from the grinding surface of the crown would indicate their adaptation to crushing harder and coarser substances than the more complex but weaker teeth of the elephant. Their limbs are proportionally shorter than the elephant though constructed on the same type, but the leg bones are stronger, cranium flatter, and from the smaller development of the frontal air cells, it presents a less intelligent character.

Other Mastodon remains discovered in Asia present the transitional character of the teeth of the elephant and the Mastodon. For the Mastodons with three-ridged penultimate and ante-penultimate grinders, Dr. Falconer proposed the name *Trilophodon.* The species *Mastodon americanus* of Cuvier was described in 1798; *M. ohioticus* in 1799; *M. giganteus* in 1817. Both the latter are the *M. americanus* Cuvier, which is the proper name by priority.

The *Mastodon* first appeared in the Miocene, being there represented by four European and three Indian species; occurring also in the Pliocene and Post-Pliocene.

The Mastodon bones first found were supposed to be the same as the Siberian Mammoth. He was called the "Big Buffalo" by the Indians, and they had traditions of his former life here. In Jefferson's Notes on Virginia a Delaware chief informed the Governor of Virginia "that in ancient times a herd of these tremendous animals came to the Big-Bone licks, and began a universal destruction of the bear, deer, elks, buffaloes and other animals which had been created for the use of the Indians; that the Great Man above, looking down and seeing this, was so enraged that he seized his lightning, descended on the earth, seated himself on a neighboring mountain, on a rock on which his seat and the print of his feet are still to be seen, and hurled his bolts among them till the whole were slaughtered, except the Big Bull, who, presenting his forehead to the shafts, shook them off as they fell; but missing one at length, it wounded him in the side; whereon springing round, he bounded over the Ohio, over the Wabash, the Illinois, and finally over the great lakes, where he is living at this day."

THE ANTIQUITY OF MAN AND THE ORIGIN OF SPECIES.

BY PRINCIPAL J. W. DAWSON, MONTREAL, P. Q.

Among the numerous books and articles constantly inviting the attention of readers to the subjects of evolution and the antiquity and origin of man, some are rather of an argumentative and polemical character than of the nature of original investigation; others relate to new facts, and constitute actual contributions to the data of questions as yet too scantily supplied with fundamental truths. Of the former class many are interesting, able, and suggestive; but it is on work of the second class that the actual settlement of these disputes must depend, though in the meantime this may be comparatively unknown to the general reader, whose ideas as to the present state of these questions are likely to be derived rather from the confident assertions and well-put arguments of popular writers than from the more solid though less showy and far less startling and less assured conclusions of actual painstaking work.

Of works which may claim to contain results of original and useful investigation, the following, which are now in the hands of scientific men and embrace a very wide range of inquiry, may afford the material for profitable discussion in this REVIEW: Dawkins on "Early Man in Britain" is a work limited in its range, but embracing the results of the investigations of an acute obsever, well up in the paleontology of the more recent formations. Barrande's "Brachiopods," extracted from the great work on the Silurian System of Bohemia, is the production of the first paleozoic paleontologist of our age, and with regard to the group to which it relates, as well as to the cephalopods and trilobites previously treated by the author in the same manner, is an exhaustive inquiry as to what they have to say for and against evolution. "Les Enchaînements du Monde Animal," by Gaudry, may be regarded as a popular book; but it is the work of one of the most successful collectors and expositors of the Tertiary mammalia. "Le Monde des Plantes," by Saporta, is also in some degree popular in its scope, but is replete with scientific facts admirably put together by a most successful and able paleo-botanist. Of the above writers Barrande is an uncompromising opponent of evolution as ordinarily held. In other words, he finds that the facts of the history of life in the Paleozoic period lend no countenance to this hypothesis. The others are theistic evolutionists, holding the doctrine of derivation with more or less of modification, but not descending to the special pleading and one-sided presentation of facts so common with the more advanced advocates of the doctrine. Perhaps we may most clearly present the salient points brought out in these works by noticing first the successive Tertiary periods and their life, culminating in the introduction of man, and secondly the facts as to the introduction of those earlier creatures which swarmed in the Paleozoic seas.

The Tertiary or Kainozoic period, the last of the four great "times" into which the earth's geological history is usually divided, and that to which man and the mammalia belong, was ingeniously subdivided by Lyell, on the ground of percentages of marine shells and other invertebrates of the sea. According to this method, which with some modification in details is still accepted, the *Eocene*, or dawn of the recent, includes those formations in which the percentage of modern species of marine animals does not exceed 3½, all the other species found being extinct. The *Miocene* (less recent) includes formations in which the percentage of living species does not exceed 35, and the *Pliocene* (more recent) contains formations having more than 35 per cent of recent species. To these three may be added the *Pleistocene*, in which the great majority of the species are recent, and the *Modern*, in which all may be said to be living. Dawkins and Gaudry give us a division substantially the same with Lyell's, except that they prefer to take the evidence of the higher animals instead of the marine shells. The Eocene thus includes those formations in which there are remains of mammals or ordinary land quadrupeds, but none of these belong to recent species or genera, though they may be included in the same families and orders with the recent mammals. This is a most important fact, as we shall see, and the only exception to it is that Gaudry and others hold that a few living genera, as those of the dog, civet, and marten, are actually found in the later Eocene. In the case of plants, as we shall find, Saporta shows that modern genera of land plants occur before the Eocene, in the last great group of the preceding period, and we have abundant American evidence of the same fact. As in the Mosaic narrative of creation, the higher plants precede by a long time the higher animals. The Miocene, on the same mammalian evidence, will include formations in which there are living genera of mammals, but no species which survive to the present time. The Pliocene and Pleistocene show living species, though in the former these are very few and exceptional, while in the latter they become the majority.

With regard to the geological antiquity of man no geologist expects to find any human remains in beds older than the Tertiary, because in the older periods the conditions of the world do not seem to have been suitable to man, and because in these periods no animals nearly akin to man are known. On entering into the Eocene Tertiary we fail in like manner to find any human remains; and and we do not expect to find any, because no living species and scarcely any living genera of mammals are known in the Eocene; nor do we find in it remains of any of the animals, as the anthropoid apes for instance, most nearly allied to man. In the Miocene the case is somewhat different. Here we have living genera at least, and we have large species of apes; but no remains of man have been discovered, if we except some splinters of flint found in beds of this age at Thenay in France, and a notched rib-bone. Supposing these objects to have been chipped or notched by animals, which is by no means certain or even likely, the question remains, was this done by man? Gaudry and Dawkins prefer to suppose that the artificer was one of the anthropoid apes of the period. It is true that no apes are known to do such work now; but then other animals, as beavers and birds, are artificers, and some extinct animals were of higher powers than their modern representatives. But if there were Miocene apes which chipped flints and cut bones, this would, either on the hypothesis of evolution or that of creation by law, render the occurrence of man still less likely than if there were no such apes. For these reasons neither Dawkins nor Gaudry, nor indeed any geologists of authority in the Tertiary fauna, believe in Miocene man.

In the Pliocene, as Dawkins points out, though the facies of the mammalian fauna of Europe becomes more modern and a few modern species occur, the climate becomes colder, and in consequence the apes disappear, so that the chances of finding fossil men are lessened rather than increased in so far as the temperate regions are concerned. In Italy, however, Capellini has described a skull, an implement, and a notched bone supposed to have come from Pliocene beds. To this Dawkins objects that the skull and the implement are of recent type, and probably mixed with the Pliocene stuff by some slip of the ground. As the writer has elsewhere pointed out,* similar and apparently fatal objections apply to the skull and implements alleged to have been found in Pliocene gravels in California. Dawkins further informs us that in the Italian Pliocene beds, supposed to hold remains of man, of twenty-one mammalia whose bones occur, all are extinct species except possibly one, a hippopotamus. This of course renders very unlikely in a geological point of view the occurrence of human remains in these beds.

In the Pleistocene deposits of Europe—and this applies also to America—we for the first time find a predominance of recent species of land animals. Here, therefore, we may look with some hope for remains of man and his works, and here, according to Dawkins, in the later Pleistocene they are actually found. When we speak, however, of Pleistocene man, there arise some questions as to the classification of the deposits, which it seems to the writer Dawkins and other British geologists have not answered in accordance with geological facts, and a misunderstanding as to which may lead to serious error. This will be best understood by presenting the arrangement adopted by Dawkins with a few explanatory notes, and then pointing out its defects. The following may be stated to be his classification of the later Tertiary:

I. Pleistocene Period: the fourth epoch of the Tertiary, in which living species of mammals are more abundant than the extinct, and man appears. It may be divided into—

* "Fossil Men," 1880.

(*a*) *Early Pleistocene*, in which the European land was more elevated and extensive than at present (First Continental Period of Lyell), and in which Europe was colonized by animals suitable to a temperate climate. No good evidence of the presence of man.

(*b*) *Mid Pleistocene.* In this period there was a great extension of cold climate and glaciers over Europe, and mammals of arctic species began to replace those previously existing. There was also a great subsidence of the land, finally reducing Europe to a group of islands in a cold sea, often ice-laden. Two flint flakes found in brick earth at Crayford and Erith in England are the only known evidences of man at this period.

(*c*) *Late Pleistocene.* The land was again elevated, so that Great Britain and Ireland were united to each other and to the continent (Second Continental Period of Lyell). The ice and cold diminished. Modern land animals largely predominate, though there are several species now extinct. Undoubted evidences of man of the so-called "Paleolithic race," "Riverdrift and Cave men," "Men of the Mammoth and Reindeer periods."

II. Prehistoric Period: In which domestic animals and cultivated fruits appear; the land of Europe shrinks to its present dimensions. Man abounds, and is similar to races still extant in Europe. Men of "Neolithic age," "Bronze age," "Prehistoric Iron age."

III. Historic Period: In which events are recorded in history.

I have given this classification fully, in order to point out in the first place certain serious defects in its latter portion, and in the second place what it actually shows as to the appearance of man in Europe.

In point of logical arrangement, and especially of geological classification, the two last periods are decidedly objectionable. Even in Europe the historic age of the south is altogether a different thing from that of the north, and to speak of the prehistoric period in Greece and in Britain or Norway as indicating the same portion of time is altogether illusory. Hence a large portion of the discussion of this subject has to be called by our author "the overlap of history." Further, the mere accident of the presence or absence of historical documents cannot constitute a geological period comparable with such periods as the Pleistocene and Pliocene, and the assumption of such a criterion of time merely confuses our ideas. On the one hand, while the whole Tertiary or Kainozoic, up to the present day, is one great geological period, characterized by a continuous though gradually changing fauna and series of physical conditions, and there is consequently no good basis for setting apart, as some geologists do, a Quarternary as distinct from the Tertiary period; on the other hand there is a distinct physical break between the Pleistocene and the Modern in the great glacial age. This in its arctic climate and enormous submergence of the land, though it did not exterminate the fauna of the Northern Hemisphere, greatly reduced it, and at the close of this age many new forms came in. For this reason the division should be made not where Dawkins makes it, but at or about the end of his "Mid Pleistocene." The natural division would thus be:

I. Pleistocene, including—

(*a*) *Early Pleistocene*, or First Continental period. Land very extensive, moderate climate.

(*b*) *Later Pleistocene*, or glacial, including Dawkins' "Mid Pleistocene." In this there was a great prevalence of cold and glacial conditions, and a great submergence of the northern land.

II. MODERN, or Period of Man and Modern Mammals, including—

(*a*) *Post-glacial*, or Second Continental period, in which the land was again very extensive, and Paleocosmic man was contemporary with some great mammals, as the mammoth, now extinct, and the area of land in the Northern Hemisphere was greater than at present. This represents the Late Pleistocene of Dawkins. It was terminated by a great and very general subsidence accompanied by the disappearance of Paleocosmic man and some large mammalia, and which may be identical with the historical deluge.

(*b*) *Recent*, when the continents attained their present levels, existing races of men colonized Europe, and living species of mammals. This includes both the Prehistoric and Historic periods.

On geological grounds the above should clearly be our arrangement, though of course there need be no objection to such other subdivisions as historians and antiquarians may find desirable for their purposes. On this classification *the earliest certain indications of the presence of man in Europe, Asia, or America, so far as yet known, belong to the Modern period alone.* That man may have existed previously no one need deny, but no one can positively affirm it on any ground of actual fact. I do not reckon here the two flint flakes of Crayford and Erith already mentioned, because even if they are of human workmanship, the actual age of the bed in which they occur, as to its being glacial or post-glacial, is not beyond doubt. Flint flakes or even flint chips may be safely referred to man when they are found with human remains, but when found alone they are by no means certain evidence. The clays of the Thames valley have been held by some good geologists to be pre-glacial, but by others to be much later, and the question is still under discussion. Dawkins thinks they may be "Mid Pleistocene," equivalent to "Later Pleistocene" of the second table above, and that they are the oldest traces of man certainly known, but in the mean time they should evidently be put to what has been called "the suspense account."

Inasmuch, however, as the human remains of the post-glacial epoch are those of fully developed men of high type, it may be said, and has often been said, that man in some lower stage of development *must* have existed at a far earlier period. That is, he must if certain theories as to his evolution from lower animals are to be sustained. This, however, is not a mode of reasoning in accordance with the methods of science. When facts fail to sustain certain theories we are usually in the habit of saying "so much the worse for the theories," not "so much the worse for the facts," or at least we claim the right to hold our judgment in suspense till some confirmatory facts are forthcoming.

Before leaving this part of the subject it may be well to remark the grand procession of mammalian life, beginning with the marsupial and semi-marsupial beasts of prey and low-browed and small-brained but gigantic ungulates of the Eocene, and ending with man. There is here unquestionable elevation in rank, by whatever means effected. Gaudry inclines to some form of evolution, though he piously refers it to the operation of the Creator. He thinks he can see traces of such evolution in the carnivorous animals, as derived from marsupials, and in the antelope and deer tribe, more especially in the development of horn and antler; and he traces the horse through a supposed ancestry of hipparia, etc., differing, however, from English and American evolutionists in making the *Paleotherium* the initial link. This is, however, a matter of taste, as these genealogies may usually be traced with equal probability or improbability through any one of half a dozen lines. But in the case of some groups of animals, and these of the highest importance, he freely admits that derivation is at fault. The elephants and their allies the deinotheres and mastodons, for example, appear all at once in the Miocene period and in many countries, and they only dwindle in magnitude and numbers as they approach the modern. Gaudry frankly says: "D'où sont-ils venus, de quels quadrupèdes ont-ils èté dèrivès? Nous l'ignorons encore." The edentates, the rodents, the bats, the manatees are equally mysterious, and so are the cetaceans, those great mammalian monsters of the deep, which leap into existence in grand and highly developed forms in the Eocene, and which surely should have left some trace of their previous development in the sea. "We have," says Gaudry, "questioned these strange and gigantic sovereigns of the Tertiary oceans as to their progenitors, but they leave us without reply," and he goes on to refer to several things in connection with their habitat, their reproduction, and their dentition or want of it, which make their sudden appearance still more inscrutable. It is refreshing to find a naturalist who, while honestly and even enthusiastically seeking to establish the derivation of animals, gives due prominence to the facts which, in the present state of knowledge at least, refuse to be explained by his theory. The reader may note here that the appearance of man fully developed in the Modern period is parallel with that of the elephantine animals in the Miocene and the whales in the Eocene, as well as with a vast multitude of other cases which meet the paleontologists in every direction.

In the world of plants, Sarporta has a strangely different story to tell, though its general plan evidently harmonizes with the history of mammalian life. If we keep out of view the few species of small marsupials that exist in the Mesozoic period, mammalian life in all its grandeur comes into existence at a bound in the Eocene. But it had been preceded for at least one great geological period by a vegetation similar to that now living. It can scarcely be questioned that the vegetation of the older geological periods, however rank and abundant, was not well suited to sustain the higher herbivorous animals. Accordingly, no such animals are known in these periods. But in the cretaceous age we find in the lower beds of that series some coniferous plants of living genera, and in the upper cretaceous modern generic forms come in, both in Europe and America, in great force. We have magnolias, oaks, beeches, ivies, ginsengs, plane-trees, poplars, palms, and a host of familiar forms, and some of these so closely resembling existing species that it scarcely requires the eyes of an evolutionist to see in them the ancestors of our modern trees. Thus an ample and long-continued preparation was made not only for the introduction of mammalian life, but even for giving to the landscape its existing features. It seems indeed strange that no precursors of the Eocene mammals have yet been found in connection with these plant remains of the newer cretaceous. There is a gap here in animal life which we may expect at some time to be filled. There seems, however, notwithstanding the great changes in climate and physical geography, to have been much less change from the cretaceous onward in the plant world than in the world of higher animal life, so that Saporta can figure series of leaves of plants of modern genera from the Eocene upward, showing so little modification that they may in some cases be regarded as scarcely more than varietal forms, while some of the species have undoubtedly survived without change through all the long ages extending from the beginning of the Kainozoic to the present day. Plant-life is in this analogous to the lower animal life of the sea, which presents the same unchanged characteristics in Eocene and Modern species.

(*To be continued.*)

ARTESIAN WELLS IN COLORADO.

CAPT. E. L. BERTHOUD.

An artesian well is one that is sunk through an inclined stratum of rock or clay, or slate impervious to water, to more porous or pervious strata underneath. Hence, unless we have inclined strata, or those inclined qua-quaversally, thus forming boat-shaped or saucer-shaped depressions, we cannot hope to succeed in sinking an artesian or water pressure well.

The increasing volume of population that is surging west of the Missouri river into what Professor Powell justly calls the arid regions of the United States, and the increasing and imperative demand that this swelling tide has for an abundant and perennial supply of water, is one that justly demands immediate and paramount attention on the part of State, local, and (above all) general government authorities.

It is not the design here to enter into any details of where and how we must or do use water, but simply to discuss the subject of water supply in its various forms as evident to us—the causes that affect its volume and distribution, and the methods that in future may be used to enhance its supply and to render desert wastes habitable and of economic value.

Prominently before the people of Colorado is Senator Hill's appropriation (for to his efforts this is mainly due) that has been made for the purpose of sinking artesian wells in Colorado, as a trial experiment.

We will not in this sketch pretend to criticise the action of the "experts" who have decided upon the localities where our wells are to be sunk—nor do we design these remarks in any unfair spirit of criticism. The gentlemen, who have for the department in Washington the care and responsibility of this work, must have a fair chance to carry out their theories and ideas—they have publicly announced them, and until their failure or success proves them right or wrong, it is not fair to find fault. But while anxiously awaiting the final result that their borings will develop, we will examine the question of such wells in the abstract, and discuss not only the origin of the underground supplies of water we may expect to reach in Colorado, east of the main mass of the Rocky Mountains, but the constant proportion that the subterranean supply of water bears to the total meteoric supply—the amount that is carried out into the open plains country by evaporation and the streams, and lastly the topographical and geological features, favorable or unfavorable, to the project of a water supply from artesian wells.

Originally, we conceive that as late as the lower Eocene or upper Cretaceous ages, the whole region between the South Platte and Wahsatch Mountains was then an undulating surface, unbroken by any mountain range. The Rocky Mountains were then elevated, and on their flanks to the east and from the central range westward to the great basin the cretaceous strata were tilted and uplifted in great confusion. This continuous movement of elevation raised up on the east foot-hills into the jurassic and triassic and carboniferous strata existing underneath the Cretaceous, so that we can to-day walk over and examine each outcrop from the Eocene to the Carboniferous without difficulty, and each lying in a highly inclined position from the thirty-fifth to the seventieth dip.

Most prominent among the successive outcrops that we find parallel to, and continuous from the North Platte to the Spanish peaks, are the various high picturesque ridges of cretaceous sandstones and slates that like vast waves follow the contour of the granite and mica slate foot-hills, whose elevation originally disturbed their normal level with the most recent Cretaceous—or we might better say at the *point of passage* from the upper Cretaceous to the lower Eocene we find a series of formations, essentially fresh water, or estuary too in part, in which are developed a large succession of coal veins, accompanied with a large development of fire-clay and potters-clay beds, and finally overspread with a very thick deposit of green Tertiary clay, lying uncomformably upon the coal measures.

Now the inclination of the successive strata from the metamorphic eastward to the tertiary is excessive, and the ends of the strata form the general surface of the ground in the valleys and the foot-hills, each branch or affluent of the Platte cutting a bed through the upturned strata until it reaches the more horizontal formations that constitute the Missouri and Platte river prairies, while a large portion of the water that comes from the central range in the shape of melted snow or summer rains is taken up and stopped by the more porous and open sandstone strata that form the beds of the streams when they leave the mountain cañons on their way to the South Platte, the North Platte, and the Arkansas. This amount of water from the streams whose supply comes from the central range, joined to that which, as melted snow and as rain, is taken up and absorbed all over the foot ranges of our mountains, finally reaches our porous sedimentary strata at the foot of the mountains, and follows down their fissures and faults until they either reach the impenetrable fire-clay walls of our coal formation, or else the great clay deposit overlying the coal, and east of the coal veins, either of these clay deposits being sufficient to arrest the outward flow of the drainage of our mountain range, thus acting as an impervious wall or dam, and forcing into the low-lying porous strata, under the clay, a vast volume of water, which is totally lost for any available purpose. It is evident, however, that in Jefferson and Boulder counties, where the coal formation is extensively developed, that the amount of water absorbed and which passes under the great clay deposit that overlies the coal, is of very small volume compared to that which is stopped by the fire clay beds in the coal deposits against whose face the whole mountain drainage is finally accumulated, and which it follows to an almost unknown depth.

We have been, perhaps, too particular in our local remarks touching the sequence of our geological deposits, and their situation in respect to the configuration and drainage of our mountain range, and its outliers to the East, formed of sedimentary rocks, but we consider these details as absolute, not only in general accuracy, but as necessary to develop the theory we have formed, based on their sequence and position.

In accordance, then, with the preceding description of the geological and lithological formation of the strata adjacent to the Rocky Mountains, between the thirty-eighth and forty-first degrees of latitude, we believe to make the boring of an artesian well a success, that we must select a point for that undertaking immediately east of the outcrop of the coal formation, or failing to find and identify in any one spot the presence of the great lignite beds bordering the foot-hills, we must sink down through the great green clay deposit that overlies this formation, until we reach the sandstone strata beneath it. For whenever the vertical boring in the coal formation reaches the sandstone and slates beneath the coal, we will find abundant supplies of water derived from the higher lands west of them. The same, but in a lessened degree, will be the case when we bore the great tertiary clay deposit overlying the coal measures unconformably.

Now it has been shown from the result of the artesian well borings made by Captain Pope in the *Llano Estacado* and also in New Mexico—by the borings made near Carson, in Arapahoe county, and also by one or two attempts made between the South Platte and the foot-hills near Golden—that although water was found in boring down in every instance, yet it signally *failed to reach the surface* by hydrostatic pressure. We believe this is due to two causes:

1. That until such borings have been extended downward sufficiently to reach either the Tertiary clay, or cretaceous coal shales or clays, the fillets of water that are found are due either to local drainage, or—

2. They are obtained from the scattered crevices or cleavage planes existing everywhere in the porous sandstone and slates underlying the whole region embraced in our remarks—and that this universal diffusion of small underground veins, not derived from the higher mountains to the west, is the reason of their failure to reach the surface, or to overflow above it.

We need not here allude to the well-known fact of the scarcity of springs everywhere in the prairie region of Colorado, and to their comparatively reduced numbers everywhere in the foot-hills, where we find the upturned "hog-backs" are formed of sandstone, limestone or slate, while we find them always beyond the upturned coal measures.

The writer of this article was the witness, some eighteen years ago, of an effort made by the war department to obtain water near Fort Lyon for the quartermaster's herd, north of the Arkansas river. A well was dug some thirty feet in tenacious clay, then borings were carried on some thirty or forty feet deeper. The clay continued the same at the farthest depth attained, but not one drop of water was obtained, and the effort was given up as wholly useless, although begun in the bed of a dry affluent of the Arkansas.

To make an artesian well practically and fully useful, we must draw from the underground resources that are derived from our vast mountain ranges. The local rainfalls of the great plains west of 100 degrees west longitude are too scanty in amount to ever be of much practical benefit, the rapid slope of the plains and the excessive evaporation from their treeless surfaces rendering that supply precarious and the effect of but short duration. The effect of hard rain in this part of Colorado is to drain away rapidly into the Arkansas, Smoky Hill and Republican rivers, by the numerous dry ravines that radiate from those rivers. Their waters rise very high in a few hours, the water drains rapidly away, but its retention on the surface is very light in amount from the scanty nature of the herbage clothing the ever parched prairies.

From observations taken at Fort Sedgwick, Fort Russell, Cheyenne, Denver, Fort Reynolds and Fort Lyon, on the Arkansas, the yearly rain fall will average over that region about 13.21 inches.

The average along the Colorado foot-hills is about 17.30 inches.

The average for Clear Creek valley in the mountains, as far as Georgetown, Bakerville, Black Hawk and Central, is about 18.75 inches.

The rain fall and melted snow for the higher points above these, including the central range, will give yearly an approximate amount of 31.50 inches; or for the whole area of Clear Creek valley west of the range line, between ranges 69 and 70 west, amounting to about 400 square miles, we have a mean approximate amount yearly of rain and melted snow of 20.62 inches.

This gives us then for the Clear Creek water shed of 400 square miles a yearly amount of 19,068,800,000 cubic feet of water.

Now Clear Creek gives us from a series of measurements begun in September, 1860, and extended to March, 1880, an average discharge at Golden, Colorado, of 5,850,000,000 cubic feet per year. This amount, subtracted from 19,068,800,000, gives us 13,213,300,000 cubic feet of water that is lost to us by evaporation, or which, settling into the ground, is practically lost, unless sought for by digging, or returned to us through artesian wells in the foot-hills.

In other words, of all the rain and snow-fall received in the Clear Creek water-shed sixty-eight per cent. is lost to us and thirty-two per cent. is discharged by Clear Creek where it enters the plains.

Hence for Denver and South Platte valley, of the 13.77 inches rainfall at Denver, 9.37 inches of water are lost by evaporation, or sinks into the ground.

At Cheyenne 6.9 inches are accounted for in the same way, from a yearly fall of 10.14 inches.

At Fort Lyon, on the Arkansas river, the yearly rain and melted snow is 12.50 inches, of which 8.54 inches are lost from the same causes.

Basing the above figures on the same percentage as Clear Creek valley, we are inclined to believe that the chances of obtaining subterranean supplies of water from artesian wells are *inversely* proportioned to their distance from the mountain range, and that the great diminution of rainfall from the main range eastward, already so much noted at Denver, is still more apparent as we go toward 102 and 101 degrees of west longitude in the Platte and Arkansas valleys.

And that to attempt to bore for permanent supplies of water east of parallel 105, in Boulder, Jefferson, Arapahoe, Douglas, Bent or Larimer counties, will be infructious or unsatisfactory, and cannot, we believe, lead to the discovery and delivery of large, permanent supplies of water.

The figures given for the rainfall for Clear Creek valley, the supply of water, etc., etc., are solely from the writer's own data. For the outside localities they are obtained from the United States signal service office, Smithsonian Institute, Prof. Powell's "Arid Regions," etc.

THE MIOCENE BEDS OF THE JOHN DAY RIVER, OREGON.

CHARLES H. STERNBERG, ELLSWORTH, KANSAS.

These beds consist principally of clay, with here and there a stratum of green sandstone. They are often covered with a cherty clay rock, that has been subjected to a great heat. Twelve or fifteen hundred feet of lava cover the deposit, and in many places dykes run across the country and through the tertiary beds. Here the earth has cracked and poured out its oceans of lava, where these dikes are exposed; they resemble rows of cord wood, the basaltic columns lying horizontal. The clay beds are of various colors, red, green and yellow, with all the intermediate shades. These bright colors form a pleasing landscape, especially where the elements have worn the beds into Bad Land scenery, while above, rises escarpment after escarpment of basaltic columns. The distant summits are crowned with forests of pine. The rocks, as I have said, are chiefly clay, which have been softened on the surface by rain and frost into soft earth, into one sinks a foot or more. Beneath this the rock is solid and hard to work. Great numbers of concretions are scattered through the beds. They are from a few inches to several feet in diameter. In places these concretions are arranged in rows one above the other one hundred feet in height, and the bed looks as if the rock had been faced with mortar and cannon balls six inches in diameter stuck into it in regular rows. Through the clay beds are often found vertical seams of carbonate of lime. The beds are hard to explore, as they are almost perpendicular, with here and there a narrow projecting shelf that gives a precarious foothold. Only persons who have had long experience in collecting, and who have enthusiasm enough to risk their lives for science, can hope to meet with success; otherwise they will go away with no specimens, or only fragments some friendly wash has carried to a level place. The beds differ from any that I have ever explored, and a day's climbing among them would convince any but an experienced collector that they were destitute of fossils. The amount of labor required to wrest from Dame Nature her hidden treasures is great, but she always rewards persistent effort. I have more than once explored a locality for two weeks without success, and then found a splendid specimen in the very ground I had gone over again and again.

For nine or ten years these beds have been explored, and each year an equally rich harvest has been gathered. The fossil remains are often in concretions with eye rim, or the point of a tooth, or small portion of some other bone exposed, and you can easily see how carefully one must look, when hardly one concretion in a thousand contains anything of value. Of course, the smaller the amount of the skull that is exposed, the more perfect will be the specimens imprisoned in the friendly concretion. In the two years I worked in these beds I found great numbers of perfect skulls and many more or less perfect skeletons of various mammals, and in all my explorations in the fossil beds of the Northwest I never found such perfect specimens. At one time I got a nearly perfect skeleton of a large mammal unfortunately the skull was missing. It proved to be a new species belonging to a new genus: Cope called it *boocherus humerosus*, on account of a huge projection on the humerus. It was as large as a rhinoceros, with great pillar like limbs.

One great trouble we found in collecting was the dazzling surface of the beds we had to examine, the eyes soon becoming tired. We often had the sensation of snow blindness: five hours constant looking was a good day's work. The most abundant fossil found was the *oreoclon*, or the extinct hog, as they closely resembled that family. Three or four species were discovered, some about the size of the Texas peccary, others as large as the wild boar of Europe. I have been enabled to furnish Professor Cope a number of perfect skeletons of this genus, as their anatomy is well made out. The animals found belong to tropical countries. The rhinocerous is quite common, three or more species, one has a horn on each side of the end of the nose. The *hipparion* and other ancestors of the horse are found. One peculiar new genus I discovered was an ancestor of the South American Llama; Cope calls it *Probotherium sternbergii*. Instead of there being but one metacarpal as on the Llama, there are two pressed closely together, and, reasoning from the evolution theory, we would expect this to be the case in the ancestor of the Llama, because, in the metacarpal of the Llama, there are two projecting articulations for the attachment of two toes, and from each articulation a medullary canal extends back the whole length of the bone.

Just as Darwin reasoned, that in the early history of the horse, it must have had three toes, and that the two splint bones were the rudiments of those toes. The Oregon beds prove Darwin to be right, as horses with three toes have been found.

Among the carnivora, over ten species of dogs and tigers were discovered. One large dog had terrible fangs, longer than a tiger's, that were sharply serrate edged like a shark's. Another peculiar species had a shoulder on the lower canine, against which the point of the upper struck. This large number of carnivorous beasts show that herbivora were abundant, which we found to be the case.

Although these beds have been explored a great many years, we found new species and a number of new genera. The first year I worked in the beds I got thirteen new species. They will all be described and figured in a work by Professor Cope on the Miocene of Oregon, to be published by the Government.

Among the gnawers or rodents great numbers of species were found, from a small mouse to a beaver. I found fossil bones bearing the marks of these little rodents' teeth.

Hard-shelled turtles were the only reptiles found: they varied in size from six inches in diameter to two feet. Fresh water *unios* and other shells were abundant. The miocene beds of Oregon extend over the greater part of the eastern part of the State. Only the John Day and Crooked river have been explored. Rich harvests await the future explorer.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

November 20, 1880.

M. Deherain, in studying the origin of carbon in plants, points out the fact, that the seed retains the larger part of its reserved food for the development of the leaves, to enable them to take in at the earliest period a supply of carbonic acid. But if the seed germinates in a sterile soil, the root will become immeasurably long, just as when a plant vegetates in obscurity, the stem lengthens out in search of light, at the expense of the leaves, which, deprived of lights, can perform no function. Chlorophyll, or the green coloring matter of plants, consists according to M. Frémy, of two different susbtances, yellow and green; chlorophyll proper, is a highly agatized body, as is evident from the vigor with which wheat or grass in certain parts of a field accidently overmanured, spring up in rank green tufts during spring. Place a plant of tobacco in a poor soil, the leaves will commence to turn yellow, but add a dose of nitrogenous manures, and they will rapidly become a deep green. Light, whether it proceed from the sun or artificially, by means of electricity, is necessary for the production of chlorophyll; but M. Boehm has demonstrated by experiments on young pines, that unless a certain degree of temperature exists, the influence of the light will be next to nugatory. Chlorophyll does not allow all the rays of light to pass through its mass indifferently; some traverse it, but others are retained, absorbed, and extinguished. The intense action of sunlight, if prolonged, induces a partial decoloration of the leaves, for the chlorophyll cells, which ordinarily run together like a string of beads, coalesce and seek the edges of the leaf as if for shade from the too powerful solar action. The chlorophyll cells are the seat of one of the most important phenomena of vegetation; it is therein where takes place the decomposition of carbonic acid; it is by that intermediary that vegetation receives and augments its mass of carbonaceous matter. The air is the grand source of carbon; for example, the immense regions of sandy soil in the southwestern and northern shores of France are barren of carbon, yet pine forests flourish there not the less. The carbon comes from the air, similarly as Boussingault caused plants to grow in sterile sand by merely keeping the roots in contact with water. Priestly in 1771 demonstrated, that an atmosphere in which a candle became extinguished, enabled a plant to exist, and later, when a second candle had been introduced, it burned as usual. The plant had absorbed and appropriated the carbon of the carbonic acid produced by the combustion of the first taper, giving off in return, oxygen to enable the second to burn. It was Housz, however, who showed that the leaves decomposed carbonic acid under the influence of light. If the living leaves be deprived, pending some days, of the action of air, or plunged for a relatively short time into an inert gas, they will become incapable to decompose carbonic acid—will perish—they are simply suffocated. Some substances, mercury for example, act on the leaves so as to render them incapable of decomposing the carbonid acid; they are literally paralyzed.

Cerebral always succeeds articulate rheumatism, and invariably terminates in death. When the disease gains the head, the pains in the articulations disappear. Rheumatism of the brain commences by delirium, continues by a succession of crises—ending in about twenty-four hours, and fatally—for the rare cases of cure do not count in the struggle. The highest medical authority in France, M. Woillez, asserts the affection of cerebral rheumatism can be successfully treated, and without danger to any other existing disease of the heart or lungs—that a patient may be suffering from, by means of cold immersions, in a bath reduced to sixty-eight degrees Fahr. by means of ice, maintaining the patient therein till the first symptoms of shivering appear. The bath is to be renewed every three hours, and generally three will suffice. It is vitally important to remember that on the first appearance of the symptoms medical aid should be called in, and action at once taken; each minute's delay is a chance removed for success. Nothing but immersion must be practiced, as nothing can replace the ice bath, neither local applications of ice, nor lotions, nor wet sheets. These are only auxiliaries of the cold bath. As there is no uncertainty respecting the happy results, so there should be no hesitation to adopt the remedy. The time for the patient to remain in the bath, till the shivering sets in, may vary from ten minutes to one hour and a half. Sometimes the bath is *commenced* at eighty-six degrees Fahr., and cooled down to the sixty-eight and even sixty-four degrees. A bath at eighty-two degrees has occasionally sufficed to ward off the mortal symptoms, commencement of asphyxia. The delirium resulting from cerebral rheumatism manifests itself under the form of hallucinations, melancholy, stupor, persecution and total perversion of character, ending in coma; other symptoms are, sleeplessness, convulsions and tremblings, the last stage being asphyxia. No treatment in the history of medicine produces such prodigious results in so short a time, as immersion in the cold bath; it takes the patient in the moment of inert agony, deprived of all sentiment and reason, and in the twinkling of an eye, restores him to life. First, the danger imminent from asphyxia is conjured by respiration being established, the muscular tremblings are calmed and disappear. The delirium may not have departed—a circumstance not very important, as the primary point is attained—the living of the patient. Often the delirium will have vanished with the first bath, returning in the interval before the second; the pulse, after the bath, will have been found to have descended from 160 to 108. Pending the four or seven hours that may elapse after the bath, the patient will gradually become warm, experience a general sense of relief, then suddenly the temperature of the body will mount, but never will attain the number of degrees as before the immersion.

There is no physical theory about electricity. Neither Faraday nor Thompson attempted such; hence, why the question is being discussed. Is electricity a form of matter, or a form of force like heat and light? Clearly it must be either. Matter is all that can be perceived by the senses or put in movement be force; its properties are weight, inertia, elasticity. Force is all that which produces or tends to produce movement of matter either by pressure, tension, attraction or repulsion, so as to effect a change in the repose of matter or to modify its movement. Matter is represented by sixty-four elements, and which have up to the present resisted all means of analysis; it occupies space, and is to be met with under four forms, solid, liquid, gaseous and ultra gaseous; it is composed of molecules and atoms. An atom is the most tiny indivisible part of an element; a group of atoms of the same element, or of different elements, constitutes a molecule, and which has defined dimensions, and remains always invariably in its form for each substance. The *mass* of a substance is the reunion of the molecules of which it is composed. Atoms can neither be created nor destroyed; hence, matter is indestructible. We can only form an approximate idea of the dimensions of a molecule. According to Sir W. Thompson, if a sphere of water, large as a pea, were magnified to equal the volume of the earth, each molecule proportionally augmented would be of a volume between the sizes of a small ball of lead and an ordinary cricket ball; fifty millions of molecules placed in line, would extend to an inch. Molecules are very elastic, and when unopposed by obstacles, move rapidly and in a right line; when they move freely, they represent the *ultra gaseous* state of matter, as obtained by Crookes in almost a vacuum; when they knock against each other, following the law of elastic bodies, thus putting an obstacle reciprocally to their own movement—gas is the result; when the field of the movement of the atoms is restrained, but not wholly stopped, a *liquid* is the product, and when the attraction is sufficient to produce cohesion, to keep the molecules confined to their proper sphere, that state of matter is called *solid.* All that changes the movement of matter, or the molecules which compose it, is a form of force: Thus weight, attracting matter to the center of the globe, is a form of force; so is heat, for it determines in the molecules of matter violent vibrations, or augments the rapidity of their movements in a right line—that which produces the measure of heat, called—temperature. Light is also a form of force, being the product of the undulations of the molecules of matter, transmitted by the undulations of that *milieu* which fills all space—ether. No person has ever seen a molecule, and the mind's eye can form no idea of force. All that is mysterious and incomprehensible in nature is attributed to things not less mysterious and also as incomprehensible. This has ever been the case with such phenomena as life, heat, magnetism and electricity. For the Greeks, heat was an animal which bit, later it was accepted as a fluid, which permeated and inflamed bodies, till Rumford demonstrated it was merely a movement, and Joule a quantitative form of energy. Thales and Milet imagined the lodestone was endowed with a sort of immaterial spirit, and the Greeks concluded amber was possessed of vitality because it attracted morsels of straw. Boyle held that amber emitted a kind of glutinous fluid which carried off light objects by attracting them toward the excited body. Du Fay imagined the theory of two fluids, Franklin of one, and that Cavendish completed, but it was Faraday who discovered the molecular theory of electricity, and Grove ranked it with light and heat as being a force of the same nature and simply a mode of movement. Deprived of dimension, inertia and elasticity, electricity cannot be a form of matter; consequently it is a form of force like sound, light and heat. The analogy between the conductibility of the different metals for heat and electricity is such, that were the metals pure, their manner of conductibility would be the same. When an electric current passes through a metallic wire, it heats the metal, and to a degree proportionate to the intensity of the current, till the wire becomes incandescent. All electric discharge is but a violent molecular movement, and this view is corroborated by the fact, that in vacuum, the discharge cannot take place. M. Plouké has shown that fine wires, traversed by powerful currents, present regular ripples, some peculiar crackings, causing the metal to become peculiarly brittle; hence, the vibratory movement of the molecules. M. Siemens calculates that New York could be illuminated by the force of the water falling at Niagara, and that a plow could be worked—the writer has seen such on the estate of M. Menier, as well as cranes worked for unloading barges—by the transmission of electricity along an ordinary wire, generated by a machine one-third of a mile distant from the implement. Science can determine the quality of steam necessary to produce an electric current of a certain intensity, to yield a certain quantity of light; to determine the volume of a cable necessary to transmit instantly to the other side of the world a fixed number of words, and even when a break occurs in a cable, the point of interruption can be calculated to within a few yards. All this energy, all this power, is clearly a form of force.

No precise ideas exist respecting ozone, it is only of late that the attempt has been made to distinguish it from oxygen; the truth is, the physical properties of ozone are, up to the present, hardly known and cannot be distinguished from those of oxygen. Messrs. Hautefeuille and Chapus have just prepared by low temperature and strong pressure, a mixture very rich in ozone, and peculiarly characterised by a blue or azure color. The same gentlemen are at present occupied examining the *role* of that coloring gas in the atmosphere and its influence in diverse radiations.

There is nothing positively known by Science respecting the cause of whooping-cough, its evolutions, or its remedy. Doctors at best can only prescribe palliatives. It is an affection grave, entailing a mortality of five to ten per cent. It was generally considered that the inhalation of the vapors in the atmosphere around gas works was an infallible remedy, but M. Roger has gone into the matter with the gas companies, who conclude, the children who do not return have been cured. The inhalation neither lessens the period of evolution of the disease, nor amends its nervous, febrile stages.

PROCEEDINGS OF SOCIETIES.

FINAL PAPERS READ AT THE NATIONAL ACADEMY OF SCIENCE MEETING.

The fall meeting of the National Academy of Sciences closed with five of the most brilliant papers on the list, and the Academy was declared adjourned by Prof. Marsh without a farewell address or other literary entertainment. Including the biographical notes by Prof. Cope, the Canids and Mimoravids of the Miocene formation of the West, and the memorandum of Prof. James Hall on the Relation of the Oneonta and Montrose sandstones to the sandstones of the Catskill Mountains, some twenty-seven papers have been read, many of them of permanent value, and some of them (such as Prof. Langley on the thermal balance, and that of Prof. Wolcott Gibbs on the application of electrolysis to the quantitative determination of metals in (solutions) constituting landmarks of progress in their respective fields. Prof. Henry Draper's photographs of the nebulæ of Orion must also be mentioned as contributions of the highest significance in physical astronomy, although not ranking, perhaps, with his brilliant discoveries from study of the solar spectrum. The objective lens with which this remarkable feat in photography was accomplished, was one of four which were manufactured according to a formula devised by Mr. Lewis M. Rutherford, of this city. It was originally manufactured to order for the Portuguese Government, and Mr. Rutherford was decorated a Knight of the Order of St. Ignacio in rcognition of his services. It differs from ordinary telescopic objectives in forming the image from the rays employed in photographing, not from those that are transmitted to the eye by a lens of the common pattern. Without this lens it would be impossible to obtain a photograph of the nebulæ of Orion. The several memoirs of Prof. Agassiz have dealt, in one way or another, with the results obtained by the last expedition of the steamer Blake, of the United States Coast and Geodetic Survey. As *Nature* for September 30 remarks, the work performed by the Coast Survey has received too little attention from the scientific classes in this country, and its brilliant results are but vaguely appreciated. An official report of the work done by the Blake under the superintendence of the Hon. Carlile P. Patterson, not, however, embracing its results in natural history, has recently gone through the government printing office at Washington. It was prepared by Lieutenant Commander Charles D. Sigsbee, of the Blake, to whose invention and fertility of resources the expedition owes a large part of its success. The work of the Bibb and Hassler, which preceded the Blake in this field, has been rendered familiar to naturalists through the memoirs of the late Count Pourtales; but the biological observations more recently obtained by the Blake have not yet been rendered fully accessible. They are in course of publication under the direction of Prof. Agassiz, but only a part of the series has yet appeared. The memoir of Prof. Marsh on the dimensions of the brain and spinal cord in extinct reptiles, as compared with living representatives of the same genera and species, and Prof. Ogden N. Rood's extraordinary paper on high vacua, must also be reckoned as contributions of which American scientists may well speak with pride. On the whole, the volume of transactions for 1880 will compare favorably with any preceding volume since the National Academy of Sciences was founded, and will be sought with avidity and treasured with solicitude by the ablest representatives of science in Europe as well as in the United States. There has been absolutely no padding in the papers read; few have exceeded twenty minutes in delivery; the majority have occupied not more than ten or fifteen minutes.

The first paper on the list was by Prof. Henry Draper, on "Photographing the Nebulæ of Orion," the text of which was as follows: "The gaseous nebulæ are bodies of interest, because they may be representing an early stage in the genesis of stellar or solar systems. Matter appears to exist in them in a simple form, as indicated by the simple spectrum of three or four lines. It is desirable, therefore, to ascertain what changes occur in the nebulæ, and to determine, if possible, the laws regulating their internal movements. Drawings have been made of some of the nebulæ, and especially of the nebulæ in Orion, for upward of 200 years. But drawings are open to the objection that fancy or bias may distort the picture, and it is therefore difficult to depend upon the result and compare the drawing of one man with that of another. To apply photography to depicting the nebulæ is difficult, because these bodies are very faint, and, of course, owing to the earth's motion and other causes, they seem not to be at rest. They require a large telescope of special construction, and it must be driven by clock-work with the greatest precision. All such difficulties as those arising from refraction, flexure of the telescope tube, slips of loose bearings, atmospheric tremor, wind, irregularities of the clock-work, foggy or yellow state of the air, have to be encountered. The photographic exposure needed is nearly an hour, and a slip or movement of a very small fraction of an inch is easily seen in the photograph when it is subjected to a magnifier.

"The means I have used to obtain what is now presented to the Academy are as follows: First, a triple achromatic objective of eleven inches aperture mark according to the plan of Mr. Lewis M. Rutherford, for correcting the rays especially used in photographing. This telescope is mounted on an equatorial stand, and driven by clock-work that I have made myself. The photographic plates are bromo-gelatine, and are about eight times as sensitive as the collodion formerly employed. As to the picture itself, it will be observed in the copies before you that the nebula is very distinct in its bright position. The stars of the trapezium, and some others, are so greatly over-exposed that under the magnifying power employed, namely, 165 times, they assume a large size, partly from atmospheric tremor and partly from other causes. In the lower right hand corner of the picture is a photograph of the trapezium of only five minutes' exposure, and this shows the individual stars plainly. The nebulæ present a knotted structure, as if a process of aggregation was going on, but on this topic I will not make any statement until I have a larger collection of original negatives, so as to determine what effects different lengths of exposure will produce. I should add that it is more probable that much more of the nebulæ will be obtained in the pictures taken in the clear winter weather. This photograph was made at the end of September, when there was some fog and yellowness in the air, but, nevertheless, the original shows traces of the outlying streamers seen in the drawings of Lord Ross, Trewvalet, Band, Lassell and others. A series of photographs taken during various parts of the winter season, and in different years, will give the means of determining with some precision what changes, if any, are taking place in this body."

Copies of the photograph in the form of an artotype enlargement were presented, which will be preserved by the recipients as the first ever successfully executed. The negative was taken on September 30, the exposure being fifty-one minutes. The large stars of the constellation are somewhat indistinct from the over-exposure necessary to obtain an impression of the nebulæ. In the lower right hand corner appears a small photograph of the trapezium alone, with only five minutes' exposure.

The second paper on the list was an extremely abstruse dissertation by Prof. George F. Barker, of the University of Pennsylvania, on "Condensers for Currents of High Potential." The reading occupied fifteen minutes, and was followed by the memoir of Prof. C. S. Peirce, of the United States Coast and Geodetic Survey, on the "Ellipticity of the Earth as deduced from Pendulum Experiments"—a work upon which the author has been for many years engaged, and in the course of which he he has arrived at some new conclusions. The experiments were undertaken at the instance of Superintendent Patterson, of the Coast Survey, and their results, as communicated to the scientific world from time to time, have been highly commended by European mathematicians. Prof. Peirce began by alluding to some of the difficulties connected with pendulum investigations, particularly those relating to the coefficients of the effect of temperature and that of atmospheric pressure. The latter was determined in 1829 by Sabine, and still later, Baily, in his review of Foster's experiments, undertook to correct all former results and to construct a coherent table. The first determination of the coefficient of the effect of temperature was that of Kater, which has long been an authority among men of science. When Prof. Peirce undertook his work, at the suggestion of Superintendent Patterson, he had before him the results of previous experimentalists. His observations have extended over a series of years, and have been conducted with appliances of extreme delicacy. Some of his conclusions are at variance with accepted doctrines. He finds, for example, that the correction hitherto made for the attraction of elevations is without actual foundation in fact. An island in the ocean, instead of making necessary a correction for its elevation above the general level, is without such influence as has previously been supposed on the vibration of the pendulum, and the same principle applies to elevations of other descriptions. In his memoir Prof. Peirce submits extensive tables of his results at different points. The paper was discussed by Prof. Peters and others.

Prof. Agassiz followed Prof. Peirce in a description of Sigsbee's gravitating trap for bringing up organisms from different sea depths and investigating the strata of marine life. Prof. Agassiz first described the instrument and compared it with the unsatisfactory bag formerly use. It consists essentially of a cylinder furnished with a sieve and valve at the bottom, which is sunk to the required depth—100, 500 or 1,000 fathoms, as the case may be—filled with water. When at the proper point for taking a haul a heavy ring is liberated and slides down the cable until it comes in contact with a device for opening the valve. The latter opens and the water flows in, displacing the volume of water contained in the cylinder, and carrying with it marine organisms living in the stratum under investigation, which are arrested by the sieve and thus lifted to the surface. The result had then, Prof. Agassiz said, was to prove there was actually no difference between the organisms at the surface and those living at a depth of fifty fathoms.

In sections of the Atlantic, so abundant at the surface in tunicate that the sea seemed actually like a moving mass of life, genera and species were as numerous and varied at fifty fathoms as they were upon the immediate surface. The next fifty fathoms contained the same types, but the genera were less numerous. They counted seventeen genera of pelagic organism upon the immediate surface in one of those investigations, but only five of them were brought up when the trap was let down to a depth of 100 fathoms. Prof. Agassiz concluded with a high compliment to the ingenuity of Commander Sigsbee, whose invention had surmounted so many difficulties connected with the study of submarine biology. He believed that the bodies of pelagic organisms brought up from great depth were the carcasses of animals that had perished of age or accident upon the surface, and had slowly settled to the bottom to furnish food for its living hosts. It required from three to four days for a dead tunicate to sink to a depth of 1,000 fathoms.

With the paper of Prof. Marsh on the "Dimensions of the Brain and Spinal Cord in Some Extinct Reptiles," the work of the season was closed. Prof. Marsh reminded the members of the academy by way of introduction that some five years ago he had contributed a paper on the dimensions of the brain in extinct mammals, and had then established the proposition that the older the type the smaller was the dimensions of the brain. Among the mammals of the Tertiary period there had been a gradual increase in the capacity of the brain-box and in the volume of the contained nervous tissue. Moreover, this increase in volume had mainly concerned the cerebral or intellectual portion of the encephalon, so that it might be urged that there had been a gradual advance in intelligence associated with this advance in brain development. Since laying before the academy his memoir on the mammalian brain he made many more observations, and in April last last, as his hearers would remember, he had the honor of laying before the academy evidence of the fact that the same law of progressive increase in cerebral volume was followed by reptiles and fishes by comparing the brains of extinct with those of surviving genera and species. In general the brains of the earlier types were not more thon one-third as large as those of the corresponding types of the Tertiary period, and this was true of all the different groups he had examined, embracing the crocodiles, dinosaurs, as well as the higher forms. He should call attention at present to the small brain of a gigantic reptilian of the jurassic formation which he had recently examined. This immense animal, though thirty feet in length, possessed a brain scarcely as large as that of an ordinary dog, as judged from the capacity of the brain cavity. But the most remarkable feature of its nervous system was an immense enlargement of the spinal cord in the sacral region, where the bone was so excavated as to form an immense vaulted receptacle several larger than the brain cavity. The sacrum consisted of four vertebræ, which were well ossified and of great solidity, and within this was contained, during the life of the animal, a posterior brain—if he might use the term—which was eight times as large as the encephalon. The point was of very curious interest, not only as a fact of fossil anatomy, but in respect to the physiological inferences that might be drawn from it, into which he did not propose to enter. It was so remarkable, indeed, that he took occasion to examine other examples of the same species before accepting it as a general fact of extensive application. Upon recurring to some younger specimens of the same gigantic saurian, he was enabled to verify the existence of the cavity in every instance, and to prove that sacral enlargement of the cord in extinct reptilians was an extraordinary fact. If it had appeared in a single instance in must, of course, have been regarded as a phenomenon due to injury or disease; but in all cases since his attention was attracted to the point by this enormous creature he had found the posterior cavity in extinct reptiles.

There was nothing analagous to this sacral enlargement, Prof. Marsh continued, in existing vertebrates. The aurphiax had absolutely no brain—that is no cerebral enlargement of the cord at the anterior extremity, but there was an enlargement of the spinal cavity at the sacrum which answered to what he had observed in extinct species. He would not take the time of his colleages by drawing any conclusion from the facts he had stated. Prof. Rood inquired if the sacral enlargement was in such a position as to furnish a point of origin for the nerves of the leg. Prof. Marsh replied that such was the case, and that the creature had very powerful hind legs. But the fore legs were equally strong, and there was no corresponding enlargement.

After concluding his paper, Prof. Marsh read the necrological roll for 1880. Three members had, he said, been removed by death, namely: J. Homer Lane, of Washington; Count Pourtales, whose name was so familiar from contributions to the literature of the Coast Survey; and Prof. S. S. Haldeman. He appointed Prof. J. E. Hilgard, Prof. Alexander Agassiz and Prof. J. J. Le Conte to prepare memorials of the deceased members. The meeting was then adjourned.

GEOGRAPHICAL.

THE HOWGATE EXPEDITION.

INSTRUCTIONS TO THE COMMANDER.

WASHINGTON, D. C., June 22, '80

LT. G. C. DOANE, U. S. A.—Sir: I take pleasure in assigning you to the command of the permanent party of the expeditionary force now on its way to Lady Franklin Bay, in the Arctic region, and I shall expect each member of said party to render full and prompt obedience to your directions.

The short time at my disposal since receiving notice of your intention to join the party, prevents me from entering into detail, and I shall, therefore, limit myself to a few general directions, leaving the details to be arranged in accordance with your own judgment, after reaching the location of the permanent station.

1st. If unable to reach the latitude of Lady Franklin Bay, and being forced to return to the United States during the year, you will *land* the *material for the house*, and also the *pemmican*, at the farthest northing made, taking such note of the location as will enable it to be readily found by any succeeding party.

2d. On reaching Lady Franklin Bay, your first care will be to examine the coal bed reported by the British Expedition, and ascertain if coal can be easily secured in sufficient quantities to supply your party with all necessary fuel. If satisfied of this, you will make a statement of the fact in writing, and having this paper signed by *all* the members of the party proposing to remain, will send it to me by the captain of the Gulnare. You will then leave the house, lumber, pemmican and other stores, for use of the party landed, together with sufficient provisions to last you until September 1st, 1881, provided such provision can be spared by the capain of the Gulnare. If he reports that all the provision will be needed for use of the ship, you will then simply land the other supplies, and return with the vessel to the United States, bringing, of course, your party with you.

I do not wish you to run any unnecessary risk, and prefer to have you return the present season, if you are not satisfied, on reaching the station, that you can remain there and prosecute the work with entire safety and as much comfort as can be reasonably expected in such a climate.

You will please read these instructions to the members of the party, in order that they may understand their relations to you. Wishing you success and a safe return, I am, Very truly yours,

H. W. HOWGATE.

NARRATIVE OF HENRY CLAY.

The following letter from Henry Clay, Esq., to friends in this city, has been kindly furnished us for publication. Mr. Clay will remain at Rittenbenk all winter.

On Board Steamship "Gulnare," Rittenbenk, Greenland, Aug. 22.—As I will remain here in Greenland this winter, I will now begin a letter to you, in order to have it ready to be sent by the "Gulnare," on her return to Washington. Owing to a series of adverse circumstances our expedition has been a failure, and as soon as a sufficient supply of coal can be obtained, the whole party, with the exception of Dr. Pavy and myself, will return to the United States.

When I last wrote to you, we were at St. Johns, N. F.

* * * * * * *

At last, on the 30th of July, about 4 o'clock, a. m., we weighed anchor and steamed out to sea. We had rain in the morning and a dense fog all day, which prevented our taking an observation. Our course was E. NE., and we made good time; about ten knots an hour.

The next day, the 31st, after running about 230 miles, we changed our course to the north. We had no fog, but it was so cloudy all day that we could not see the sun, and hence could take no observation with the sextant. We calculated our position at noon, however, by "dead reckoning," and found it to be about 52° N., longitude 50° W.

August 1st was clear and beautiful. Our position at noon was lat. 53° 47′ N., lon. 46° 50′ W. At night we had rain and fog.

The next day was so cloudy that we could take no observation. It was the first Monday in August, election day in Kentucky, and I could not help thinking of what was transpiring in Louisville. I wondered who would be elected prosecuting attorney; if Gen. Duke would be re-elected; if Humphrey would be elected, and all the other candidates. I believe I am personally acquainted with them all. But I was soon roused from these meditations, for about 2 p. m., a terrific gale sprung up from the northeast. The sea ran very high, and the vessel rolled and pitched at a fearful rate. For the first time in my life, I felt a little sea sick, but I managed to hold my own, and was soon all right again. The storm continued all night, and the next morning increased in violence. Our captain and mate, both old whalers, said it was the severest gale they had ever encountered in that latitude. The waves seemed literally mountains in height and every few minutes broke over the deck with a noise like thunder, shaking the vessel from stem to stern. Half the time our deck was under water. The captain looked serious, but said nothing, except to give orders to the crew. One of our whaleboats was washed away, the bulwarks on our quarter-deck were stove in and we leaked badly. The water came into the cabin and flooded everything and everybody. A large part of the material for our house had been stored away on deck, which rendered the vessel somewhat top-heavy, and prevented her from righting herself when a wave dashed over her. All this had to be cast overboard, and as I saw it leave, plank by plank, I felt that the colony at Lady Franklin Bay was a dream of the past.

All this time the water came pouring in streams into the cabin. We knew that something was wrong, but not until we arrived at Godhaven did we ascertain the cause. We then found that a large plank, nine feet long by fourteen inches wide, had been torn from our starboard quarter, and several others loosened. This was above the water-line, but every wave that dashed against it poured a stream of water into the cabin. The gale continued with unabated strength until 2 o'clock on the morning of the 4th, when it died away as suddenly as it had come. When I went on deck at 7 o'clock the sea was perfectly smooth, with just enough swell to give a gentle motion to the ship. We seemed to glide almost instantaneously from a rough sea into smooth water. We had passed Cape Farewell, and I think the coast of Greenland protected us from the gale. This is the only way I can account for the sudden change.

Though we did not get a sight of the cape, we saw some of the icebergs which usually hang about it. They were so numerous that on the horizon they appeared like a continuous, impenetrable line of ice. Some of them were very large, and they assumed almost every conceivable shape. About 7 o'clock we caught a glimpse of land, and at 12:30 we passed in sight of Cape Desolation, most appropriately named.

We steamed along all day, August 5, in sight of the coast of Greenland, which was not more than ten miles off. I will not say anything about "Greenland's icy mountains," the hackneyed phrase repeated by so many travelers, but most of the coast was mountainous, and nearly every mountain was crowned with ice and snow. Between the mountains were deep ravines, and the ravines were filled with glaciers extending inland as far as the eye could reach. The sea was smooth and the weather pleasant, so I spent most of the time on deck.

The days had been gradually growing longer as we proceeded north. This night (August 5) the sun set about 9 o'clock, but there was really no darkness—it was twilight all night. At 12 o'clock I was able to read the writing in my diary. We could follow the course of the sun after it set by a broad streak of brilliant red on the horizon, which increased in brilliancy and dimensions until the sun reappeared at 3 A. M. It was the most beautiful sight I ever saw. The weather was mild and pleasant and the sea as smooth as glass, I was on deck until very late, or, rather, early. Indeed, the deck was at that time decidedly more comfortable than my state-room, for my bed had been saturated with water during the storm.

An aurora tried to display itself, but made such a poor show in the bright twilight that it soon retired in shame.

The following day was clear and pleasant in the morning, but a fog settled down about 4 P. M., and the sea became quite rough. One of the sailors, Peter Du Prince, an old salt, attributed the bad weather to the fact that Stein, our engineer, had shot several gulls the day before. This is a very common superstition among sailors. Peter said he had noticed it ever since he was a boy, and found that bad weather invariably followed when birds were shot from the ship. This "ancient mariner," Peter, is a wonderful character, but I have no time to devote to him. He says he cannot tell exactly how old he is, as he lost his papers when he was shipwrecked off Cape Horn.

On Saturday, August 8, at 5:15 P. M., we dropped anchor in the harbor of Godhaven. It is a small harbor, about 600 yards long by 400 wide, with a very narrow entrance, which cannot be seen until you are almost on it. It is, however, very safe and secure, and we were glad to rest there after our stormy passage.

KIDLISET COAL MINE, DISCO ISLAND, August 30.—I have had no opportunity to write anything since the 23d, but will now have to finish my letter, as the vessel will leave to day or to-morrow.

When I left off, we had just anchored at Godhaven. I am sorry that I have not time to give any adequate description of it or its inhabitants. The population consists of the Inspector and Governor and their families, two or three other Danes and about 130 Esquimaux. The Inspector is the chief man. He has charge not only of Godhaven, but of the whole of North Greenland. He is an educated and polished gentleman. He and his family were very kind and hospitable, as indeed were all the Danes we have met. We have received nothing but kindness from them since we have been in Greenland. The Inspector's wife is a refined and cultivated lady. She speaks English more fluently than her husband, and in conversing with us he had frequently to refer to her when at a loss for a word. Their house, the best one in the place, is well furnished, and they evidently live in a somewhat luxurious style. They invited Dr. Pavy and myself to visit them this winter, which we will certainly do if we have an opportunity. Though he has a very common name—Smith—the Inspector is somewhat aristocratic and exclusive. He and his family keep themselves aloof from the other inhabitants, and have no social relations even with the Governor. Dr. Pavy and I had to apply to him for permission to remain in Greenland. At first he was a little inclined to refuse us. He could not exactly understand why we wanted to remain. He had heard of my grandfather, and thought that our remaining might have some political significance. He thought, perhaps, that the United States had some designs on Greenland, and had sent me as a kind of spy. But when we assured him that we were merely two enthusiasts on the subject of the North pole, and that we desired to remain here this winter for the purpose of gaining arctic experiences, etc., he very promptly acceded to our request. He advised us to stop at Rittenbenk, where there are ample accommodations, and gave us a letter to the Governor of that place, directing him to receive us.

Every little settlement in Greenland has its Governor, who is, in reality, nothing more than a trader. Most of them are uneducated, but all we have seen are polite and hospitable.

The natives are mostly half-breeds, there being very few pure-blooded Esquimaux in any of the settlements we have visited. Those of Godhaven do a lively trade in seal-skin slippers and other articles. They trade for provisions, clothing etc. About the only things we had to trade with were stockings, and I believe we left a supply for several years. One of the Esquimaux, named Frederick, a consummate rascal, who can speak little English, was quite facetious on the subject of our stock in trade. He said he believed we had nothing but stockings on board, we ate stockings, the name of our ship was Stockinus, etc.

I send you some pressed flowers. They are not well pressed and do not look very pretty now, but they were beautiful when growing, and you can see from them that this is not altogether a landscape of desolation. While there are no trees, and nothing similar to them, other vegetation is quite luxuriant. The hillsides and the valleys—the country is nothing but a series of hills and valleys—are liberally covered with verdure, and I can now well understand why this land is called Greenland.

At Godhaven we had some fine sport shooting eider-ducks, which were quite numerous. By the way, I must not forget to tell you that we met Hans Christian, the Esquimau who was with Kane, and who stole a team of dogs and deserted him at Etah. He is now quite old, and is generally considered a lazy, trifling kind of a fellow.

On August 17 we had a snow storm, the snow falling to the depth of seven or eight inches.

The repairs on our ship were completed August 20, and the next day we left at 9:30 A. M. for the coal mine. We arrived at Rittenbenk—my future home—at 5:15 P. M. the same day.

Rittenbenk is situated on a small island about fifty-five miles, in a direct line, east of Godhaven. It is about the same size as the latter, and, though further from the sea, is almost as important a place. The inhabitants are all Esquimaux except the Governor (an old bachelor), his secretary and another Dane. The Governor, unlike most Governors of North Greenland, is an educated gentleman, and is very kind and hospitable. He gave us a good house, with two rooms and a kitchen, and promised to do everything in his power to make us comfortable. He can speak English pretty well, and seems to look forward with a great deal of pleasure to our company this winter.

The following day, Sunday, we took breakfast with the Governor, and I tasted reindeer and ptarmigan, for the first time, both of which were delicious. At night the natives had a dance, and, though it was Sunday, I could not resist the temptation to see it. The music was furnished by two violins in the hands of two old Esquimaux. All the modern dances were indulged in, from a quadrille to a waltz. The native ladies danced and acted the same as our fashionable ladies do on similar occasions—if anything, they danced more gracefully, as they had no dresses and skirts to encumber their motions. The men, too, were more at ease, as they were not in perpetual fear of treading on their partners' skirts. Of course, as I do not dance, I remained an idle spectator, but most of our party indulged in the sport. Indeed, the native gentlemen were kept completely in the shade, and could find no partners until our party left.

On Monday, August 23, we landed stores for Dr. Pavy and myself—everything to make us comfortable—provisions, clothing, cooking utensils, etc., and, besides, a great many books and other reading matter.

After landing our stores we left Rittenbenk for the coal mine of Kidliset, about forty miles distant. We dropped anchor that night about 10:30 in a small exposed bay, three miles north of Sakkak. The bay was very shallow, and we came near running aground. Sakkak, a small settlement, is situated on the peninsula of Nomsoak, part of the main land of Greenland. It is separated from Disco Island by Waigat Strait, about sixteen miles wide.

On the morning of the 24th, the Governor of Sakkak came on board, from whom we obtained seven natives to assist in mining coal, and at 11:30 A. M. we started across the strait to the coal mine. The wind was blowing hard and the strait was quite rough, so as there is no harbor at the mine, we were forced to put back. But, instead of going to our anchorage of the night before, we put into the harbor of Sakkak, very shallow and scarcely wide enough for a ship to swing with the tide. The Governor is the only Dane in Sakkak, and he is married to an Esquimaux. After supper I went hunting with our two engineers. After walking a long distance we succeeded in bagging nine ptarmigans, and returned to the vessel about half-past eleven o'clock. Think of shooting partridge at ten o'clock at night! We went hunting several times in this neighborhood with much better success. One day I killed fifteen and another day thirteen ptarmigans. They are similar to the pheasants or partridges we used to get in Montreal, and are delicious eating.

The next day, the 25th, we made another start for the coal mine, but the sea was still too rough for us to land, so we put back into the small bay where we had anchored Monday night. We waited there until Friday, the 27th, when, at 4 A. M., we again made the attempt to reach the mine, this time with success. The coal is found in the face of a bluff about sixty feet high, which rises abruptly from the beach. The vein of coal is about two feet thick, and extends for some distance along the face of the bluff, forty feet from the base. The coal is of an inferior quality, but burns well in our furnaces and stoves. It does not give us much heat as our bituminous coal, and burns out much quicker, but still it is much better than no coal at all.

As soon as we dropped anchor we landed a party of men and set them to mining. By supper-time we had landed on board about eighteen tons,—a pretty good day's work. We then weighed anchor and went back to our old harbor, leaving the miners, with tents and provisions, on shore. We were forced to do this on account of the insecurity of our anchorage at the mines. There was no bay or harbor of any kind, and it was exposed to the least wind that might spring up. Besides, the icebergs were a constant source of danger. The straits were full of them, and there were several large ones in our immediate vicinity. We had some narrow escapes from these, as they were borne toward us by the current or the tide. Several of them came in contact with us, and one of them carried away our anchor. Altogether, they were not agreeable companions, and we were not solicitous of forming an intimate acquaintance with them. But it seems that in avoiding them we were "jumping from the frying pan into the fire," for no sooner had we entered our harbor than we ran aground. Fortunately, however, the bottom was of mud instead of rock, and so no serious injury was done to the vessel, and at high tide we easily got afloat again.

On the 28th it snowed and rained all day, and was so cold and disagreeable that we remained at anchor. I pitied the poor fellows we had left on shore, but it seems they were very comfortable in their tents. Of course they were unable to do any mining.

Yesterday, Sunday, was mild and pleasant. We remained all day in our harbor, but the men on shore made up for the lost time on Saturday, and worked in the mine. They were excusable, I think, for it was a case of necessity. When we arrived here this morning we found about ten tons of coal already mined and sacked, ready to be taken on board. The men are now hard at work mining and loading the vessel, and the Captain expects to get off to-night. Dr. Pavy and myself will be left, either at Sakkak or Rittenbenk, and the ship will start on her return voyage.

Yesterday we purchased two seals which had just been killed by the Esquimaux, and this morning I tasted my first seal meat. It is much better than I expected it would be, and I have no doubt I will soon acquire a fondness for it. They are very abundant in the winter and can be purchased for about fiften cents apiece.

I will get one of our party to mail this in the States, and to send the flowers and slippers by express. I will get you all sorts of curiosities this winter and next spring, and will also gather more flowers and have Dr. Pavy press them for me.

You can write to me next spring. Direct to Rittenbenk, North Greenland, care of Inspector Smith, Godhaven, and send via Copenhagen, Denmark. A Danish vessel will start out about the 1st of April, which will carry the mails. If you can, send me some newspapers. The *Courier-Journal* for January 1st contains an abstract of events the previous year. If possible, please send me that.

I will keep an elaborate journal this winter, and send it to you next spring. I do not think Capt. Howgate will be disheartened by this failure, but will send out another expedition next year. By remaining here this winter I can learn the habits and customs of the natives, especially their manner of sledge-travel, and obtain other information which will be useful to me in the future. If no arctic expedition sets out next year, I will return to the United States in the fall, via Denmark.

I must now close, as I have a great deal of writing to do yet. I am secretary of the expedition, and have to get my papers in order and make a written report before I leave.—*Courier-Journal.*

THE CORWIN'S CRUISE IN THE ARCTIC REGIONS.

Capt. C. L. Hooper of the United States revenue steamer Corwin has just submitted to the Secretary of the Treasury a report of the cruise made by the Corwin in Behring Sea and the Arctic Ocean, in obedience to Department orders of May 15th last. The vessel made three trips into the Arctic regions, and its course covered the whole of the Arctic Ocean from Point Barrow on the American coast, to a point within twenty-five miles of Wrangel Land. Capt. Hooper was within three or four miles of Herald Island, and cruised on three sides of it. He was convinced that there was no human life on the island. He neither saw nor heard anything of the missing whalers. The following is a synopsis of the report:

The vessel sailed from San Francisco on May 22d, and arrived at Ounalaska on June 3d. As far north as information could be obtained it was learned, that the previous winter had been mild and pleasant. After giving in detail the movements of the vessel and the trouble occasioned by the heavy ice, the report says that the Corwin got under way from St. Michael's on June 23d, with the hope of working north inside of the ice on the Asiatic side. A stop was made at Lawrence Island to investigate the reports of the deaths of natives by starvation. At the first village about fifty had died, at the second fifty-four dead bodies were counted, and it is estimated that one hundred and fifty died at this village. At the third village twelve dead bodies were found, and the deaths are estimated at thirty. At the fourth settlement there were found three hundred alive. It was ascertained that two hundred had died there. This general starvation occurred last winter. Capt. Hooper estimates that more than four hundred natives died of starvation on this island. The cause he attributes to the continued cold and stormy weather, with quantities of ice and snow which prevented the hunting of walrus and seal, as well as to the improvident habits of the natives, who are slaves to rum.

The vessel entered the Arctic Ocean on June 28th, and returned to St. Michael's on July 3d, for coal. On the 4th, the whaler Helen Mar was boarded, and from this vessel it was learned, that the missing whalers were forty miles southeast of Herald Island, in the clear water to the northward. The Corwin started north from St. Michael's on July 10th. On July 26th, the Corwin was in latitude 70° 50′ west, longtitude 175° 03′ west, only thirty-five miles from Herald Island, where a solid pack of ice was encountered, and no further progress could be made. Polar bears and two walrus were seen north of latitude 70°. The vessel returned to Cape Thompson to pick up Lieut. Burke. Returning north, Herald Island was sighted on August 4th, thirty-five miles distant. After working through the ice the distance was decreased to twenty miles. No signs of the missing whalers or of life were visible, and the weather becoming unfavorable, the vessel was obliged to turn southward again, arriving at Plover Bay on August 10th. On the 16th she returned to thirty miles east of Herald island, and on the 17th was within seven miles of the island, which bore south-southwest. On the 20th Herald Island bore northwest a distance of ten miles. The vessel made for it and got within three or four miles, when she was stopped by ice from twelve to forty feet high. A close examination was made of the island with a glass, while the Corwin lay so near, and Capt. Hooper says he was sure there were no human inhabitants on it. It is his opinion that the ice around Herald Island was old, that for two and three years it does not leave the island free, and that the ice rarely breaks up between the island and Wrangel Land.

On August 25th the Corwin reached Point Barrow, which is the most northern point of Alaska, and lacks only twenty-five miles of being the most northern point of the continent. "On the 11th of September," continues the report, "we saw the high hills of Wrangel Land, bearing W. ¼ E. (true). We ran in toward it until we came to the solid pack, the ice having the same general appearance as that we had previously encountered in the vicinity of Herald island, except in being covered with newly fallen snow, and being consequently white. We judged the land to be about twenty-five miles away. The highest hills which seemed to be more distant, were covered with snow; others were partly covered, and still lower ones were almost entirely bare. The sight of this land repaid us to a certain extent for our disappointment in not finding Herald Island clear of ice, as we had hoped to do, in order that we might run lines of sounding and make a plan of the island.

That part of Wrangel Land which we saw, covered an arc of the horizon of about fifty degrees from N. W. ¼ N., to W. ¼ S., (true,) and was distant from twenty-five miles, on the former bearing, to thirty-five or forty miles on the latter. On the south were three mountains, probably 3,000 feet high, entirely covered with snow, the central one presenting a conical appearance, and the others showing rounded tops. To the northward of these mountains was a chain of rounded hills, those near the sea being lower and nearly free from snow, while the back hills, which probably reach an elevation of 2,000 feet, were quite white. To the north of the northern bearing given, the land ends entirely or becomes very low. The atmosphere was very clear, and we could easily have seen any land above the horizon within a distance of sixty or seventy miles, but none could be seen from the masthead.

There is a report that Sergeant Andrejew, a Cossack, reached this land in 1762 by crossing over from the main land on the ice with dog teams, and that he found it to be inhabited by a race of nomads called Krahayo. This report, however, is probably without foundation. Admiral Wrangel, who was the first to report the existence of this land, says: "They (the inhabitants of Nishne-Kolymsk,) knew a great deal about the three officers who were here in 1767, but could tell us very little about Sergeant Andrejew, who was here only five years before. They had learned generally that he had been to the Indigirka and afterward to the Bear islands, but were ignorant of his supposed discoveries, which were included in our most recent charts, and when we spoke of a land north of the Bear islands and traces of a nomad race in that direction, they treated it as a fable.' I mention this, not to prove that Wrangel Land is not inhabited, but to show, that if the Arctic exploring steamer Jeannette has been fortunate enough to reach that country, as we have reason to suppose and to hope, she is the first to do so, and her brave officers and crew should have the credit of it. Admiral Wrangel himself did not even see this land. He made his report of its existence from information obtained from the natives at Cape Joctan, that on very clear days the tops of high mountains could be seen to the northward. Capt. Kellett, Royal Navy, while cruising in the Arctic Ocean in 1845, claims to have seen Wrangel Land on August 16th. From his own statement, however, it appears that he merely caught an occasional glimpse of it through the clouds, which covered it in immense masses. Under such circumstances, as he himself admits, a mistake could easily be made. He describes the land seen by him, as being from twenty-five to sixty miles distant, and speaks of seeing distinctly the columns and pillars which characterize the higher headlands in the Arctic Ocean. If what he saw, was really land, the impossibility of distinguishing more than its general outline at such a distance must be apparent.

"I am of the opinion that Wrangel Land is a large island, possibly one of the chain that passes entirely through the polar regions to Greenland. That there is other land to the northward there can be no doubt. Capt. Keenan, then commanding the bark James Allen, reports having seen land to the northward of Harrison's Bay, a few degrees east of Point Barrow. Large numbers of geese and other aquatic birds pass Point Barrow, going north in the spring and return in August and September with their young. As it is well known that these birds breed only on land, this fact alone must be regarded as proof positive of the existence of land in the north. Another reason for supposing that there is either a continent or a chain of islands passing through the polar regions is the fact, that notwithstanding the vast amount of heat diffused by the warm current passing through Behrings Straits, the icy barrier is from six and a half to eight degrees further south on this side than on the Greenland side of the Arctic Ocean, where the temperature is much lower. As already stated, the nearest point of this land was fully twenty-five miles within the ice pack, and as the new ice had already begun to form, there appeared no possibility of reaching it. Even to remain in sight of it was to expose the vessel to great danger of becoming embayed in the ice, as the large quantity of drift ice which lay outside of us was likely to close in at any time, and remain in the pack all winter. We therefore worked out into clear water and headed to the eastward.

"Having visited every part of the Arctic that it was possible for a vessel to reach, penetrating the icy regions in all directions fifty to one hundred miles further than any vessel succeeded in doing last year, without being able to find the slightest trace or gain the least tidings of the missing whalers, we were forced to the conclusion that they had been crushed and carried north in the pack, and that their crews had perished. Had any of them survived the winter, it seems almost certain that they would have been found, either by the Corwin or by some of the whalers, all of whom were on the outlook for them during the summer. It was thought probable that the crew might have escaped over the ice and reached Herald Island, but a sight of the perpendicular sides of that most inhospitable-looking place soon banished even this small hope. As already stated, Herald Island is inaccessible to all but the birds of the air, and even were it possible for men poorly provided for such work as they were to reach the island, and to find shelter on it, starvation would be sure to follow.

Capt. Hooper reports that he learned nothing as to the whereabouts of the exploring steamer Jeannette. The report that she had been seen by the whalers entering a "pocket" in the northern pack to the northeast of Herald Island, which soon afterward closed and shut her in, was calculated to give the impression that she too had gone north in the pack. Capt. Hooper investigated this report and, it proved to be without foundation. Capt. Barnes of the whaling bark Sea Breeze reports having seen the Jeannette on Sept. 2, eighty miles south of Herald Island. This was only five days subsequent to her arrival at Cape Leidze, from which point Capt. De Long wrote that he should attempt to reach Wrangel Land via Kollutchin Bay. "This being the case," says Capt. Hooper, "he would not be likely to go in an entirely different direction, and put his ship into the pack as early as Sept. 2. His most natural course would be to keep to the westward, and, taking advantage of every lead, work in and try to reach some point on the southern end of Wrangel Land, keeping his vessel out of the pack as long as possible, in order to profit by a favorable break in the ice, and gain even a few miles in the direction in which he wished to go. Failing to get sufficiently near Wrangel Land to find safe winter quarters, he might push on and endeavor to reach the New Siberian Islands, which, although some degrees further north, are often accessible, owing to more favorable location."

Capt. Hooper says that the Jeannette is a strong vessel, well fitted for encountering ice, and her crew were thoroughly equipped for traveling over the ice, if necessary, and he believes that. even though the vessel should be embayed in the ice and her crew compelled to abandon her, there would be no difficulty in reaching the mainland; or, if in the vicinity of Wrangel Land, in crossing over the ice with boats and reaching the whaling fleet. This, however, Capt. Hooper thinks would not likely be done until the completion of explorations, which he is convinced will have to be made in dog sleds, judging from what he has seen of the ice. He says:

"To attain a high latitude with a vessel in this part of the Arctic is impossible. The whalers follow the ice pack very closely between Herald Island and Point Barrow, and never have been able to reach the 74th degree of latitude as yet, while only one or two claim to have been as far north as 73 degrees. In the Greenland seas, on the contrary, it is no uncommon thing for whalers to reach the 78th degree or even higher. I believe that nowhere else within the Arctic Circle does the ice remain permanently so far south as between Wrangel Land and Point Barrow. I have no fears for the safety of the officers and crew of the Jeannette. The fact that they have not been heard from seems to indicate that the vessel is safe and that they consider themselves able to remain another year at least. Should they be compelled to abandon the vessel and cross over to the mainland during the winter, they would find no difficulty in reaching Plover or St. Lawrence Bay, where they would be well cared for by the Tchuktchis, as, in fact, would be the case at any place on the Asiatic or Alaskan coast."

EXTRACTS AND NOTES FROM AN OLD BOOK.

THREE YEARS' TRAVEL—1763-1776—THROUGH THE INTERIOR PARTS OF NORTH AMERICA FOR MORE THAN 5,000 MILES, BY CAPT. JONATHAN CARVER, GLASGOW, 1805.

The Ottawa Indians eat a kind of bread made of corn when in the milk; they slice the kernels from the cob and knead them into paste. For this no water is needed, as the milk in corn is sufficient. They then parcel it into cakes which are inclosed in basswood leaves, place them in hot embers, when they are soon baked; the flavor is excellent.

Green Bay was called by the French the Bay of Puants or "Stinking Bay." Carver remarks that the French had a different name for lakes or rivers, etc., from that used by the Indians, for, if in the presence of the Indians they were named, or a place named which they knew, they would be very jealous, for not understanding the conversation, they would become suspicious. From this, persons have since become perplexed with two or more names for the same place or object.

Carver mentions that sumach grew in plenty, the leaf of which, gathered at Michaelmas, when it turns red, is much esteemed by the natives. They mix about an equal quantity of it with their tobacco, which causes it to smoke pleasantly. He also speaks of a kind of willow (probably dogwood, or *cornus sericea*) termed by the French *bois rouge*, in English, red wood. Its bark, of one year's growth, is a fine scarlet, becoming gray is it grows older. The bark, scraped from the sticks, dried and powdered, is also mixed by the Indians with their tobacco, and held by them in the highest estimation for their winter smoking. The Indians also used leaves of another plant called by them Legockimac, to mix with their tobacco.

Carver concludes that the Winnebagoes originally resided in New Mexico, and being driven out took refuge in more northern parts about 1660. His reasons for believing this are: First. Their inalienable attachment to the Nandowessie Indians, who now (then) live 600 miles distant. The Nandowessie Indians, I suppose to be a branch of Dacotah or Sioux. Second. Their dialect differs totally from every Indian nation yet discovered—being uncouth guttural jargon, which none of their neighbors will attempt to learn. They converse with other nations in the Chippewa language, which is the prevailing language from the Mohawks of Canada to those who inhabit the borders of the Mississippi. Third. Their inveterate hatred of the Spaniard! and an elderly chief informed Carver that forty-six winters ago (forty-six years prior to 1763) he marched at the head of fifty warriors toward southwest for three moons; that during this expedition, in crossing a plain, they discovered a body of men on horseback who belonged to the black people—for so they called the Spaniards; further states that, fearing a defeat, they waited until night and rushed upon them and killed most of them, and they took eighty horses loaded with what they termed white stone; this was probably silver and their horses were shod with it and bridles also ornamented with it. This affair probably took place on the head of Rio del Norte. The town of the Winnebagoes consisted of fifty houses, strongly built, with palisades, located on an island of nearly fifty acres. The Winnebagoes raised corn, beans, pumpkins, squashes and water melons, with some tobacco.

Carver next visited a town of the Sankies containing ninety houses, each large enough for several families. These were built of hewn planks, neatly jointed, and covered with bark so compactly as to keep out the most penetrating rain. Before the doors are sheds, where the people sit and smoke. The streets are regular and spacious. Their plantations are neatly laid out.

He next visited the Ottagammies, whom the French named Des Reynards or "the Foxes." About five miles from the junction of Wisconsin (spelled Ouisconsin) with the Mississippi, he observed remarkable ruins of a large town recently inhabited by the Indians. On the Mississippi, some miles below Lake Pepin, he perceived what seemed to have been an intrenchment or earth-work thrown up four feet high and nearly a mile in extent, and sufficiently capacious to cover 5,000 men. In form, circular, its flanks reaching the river. Though much defaced by time, every angle was distinguishable and appeared regular and fashioned with great military skill.

Near the River St. Croix there resided at that time three bands of Nandowessie Indians, called the river bands, for they chiefly dwelt near the Mississippi, and were then composed of eleven bands. Originally there were twelve, but the Assinipoils had some years previous revolted. Three bands reside near the river; the other eight were called Nandowessies of the plains, and dwelt to the westward. The names of the three river bands were Nehogatawonahs, Mawtawbauntowahs, and the Shahsiveentowas.

About thirty miles below the Falls of St. Anthony he notes a remarkable cave containing a transparent lake. He observed many rude hieroglyphics cut upon the inside of the walls.

The River St. Pierre (St. Peters) falls into the Mississippi ten miles below the Falls of St. Anthony, and was called by the natives Waddapawmencsotor.

At the Falls of St. Anthony a young prince of the Winnebagoes made an offering and address to the Great Spirit, and he considered the falls to be one of his residences. He first made an address to the Great Spirit, then threw his pipe into the stream; then the roll that contained his tobacco; next the bracelets of his arms and wrists; then a necklace of beads and wires from his neck; then his ear rings, during all of which he frequently smote his breast with great violence, threw his arms about, and appeared much agitated. He invoked that the Great Spirit would constantly afford Carver a bright sun, a blue sky, and clear and untroubled waters.

Carver passed up St. Pierre's river two hundred miles to the country of the Nandowessies of the plains. Among some of these he resided seven months. They are termed the Wawpeentowahs, the Tintons, the Arahcootans, the Mawhaws, and the Schians. The other three are the Schianese, the Chongonsceton, and the Waddapawjestin, and they dwell higher up to the west of the River St. Pierre, on unbounded plains. The Nandowessies, united, consist of over 2000 warriors. Some of them drew plans of countries, with a piece of charcoal, upon the inside of the birch tree bank. He says, never did he travel in so cheerful and happy a company. Carver states that on a branch of St. Pierre's river, called Marble river, is a mountain from which the Indians get a sort of red stone, out of which they make the bowls of their pipes. A white clay also abounds, suitable for pottery, and a blue clay that the Indians use for paint. The latter they mix with the red stone and paint themselves of different colors.

The Chippeways, he speaks of as being the nastiest people he ever saw, and speaks of a custom, named by others, of searching each other's heads and eating the prey there found.

Carver particularly describes the lakes and streams west of Lake Superior. Lake Winnepeg he spells Winnepeek, and the Missouri river he speaks of as the Messorie. He relates that it is said that in the country of the Pawnees and Mandrakes are found a species of root resembling human beings of both sexes! He also states that a little to the northwest of the head of the Messorie (Missouri) and St. Pierre (St. Peters) the Indians told him that there was a nation smaller and whiter than the neighboring tribes, who cultivated the ground.

He speaks of the Shining Mountains far West, probably the Rocky Mountains, and the natives there have plenty of gold. Further on he speaks prophetically of these mountains, of which time has proved much, and says, "These mountains are more than 3000 miles long. Probably in future ages they may be found to contain more riches in their bowels than those of Industan, Malabar, or are produced from the golden coast of Guinea, nor will I except even the Peruvian mines. West of these mountains future generations may find an asylum, whether driven from their country by the ravages of lawless tyrants, or by religious persecutions, or reluctantly leaving to remedy the inconveniences arising from a superabundant increase of inhabitants."

Carver mentions a remarkable phenomenon connected with the straits of Michillimackinack. "In seven and a half years they rise three feet, and the next seven and a half years they decrease three feet." He had no opportunity to prove it, but something was taking place.

The book contains additional information concerning the origin, customs, etc., of the Indians of the Northwest; also botanical and geological information, all interesting.

G. C. B.

THE SYNTHETIC PHILOSOPHY.

ITS THEORY OF EVOLUTION.

One of the fundamental assumptions of Mr. Spencer's Synthetic Philosophy is that Nature, as man knows it, with its myriad forms, and these with their various faculties, is the product of a process of evolution. Evolution he defines as an integration of matter and a dissipation of motion. That is to say, the growth of any thing is the accumulation together, into a definite concentrated form, of matter, which previously existed in a more diffused and mobile state. This is applied to the celestial bodies as well as animal vegetable and inorganic forms on earth. This fairly represents the universal process of growth, but it fails utterly to account for either the matter that is integrated, or the force which is the cause of the motion dissipated. It fails likewise to account for the laws by which the matter in becoming thus integrated assumes certain definite forms, and repeats these forms generation after generation.

Evolution, however, is chiefly distinguished as such, by its explanations of the facts of Biological Science. Though Mr. Spencer has sought to elaborate it into an account of all things, it is by its account of the origin of species and the descent of man, through gradual differentiations and modifications of previously existing forms, that it gets its name; and by reason of the greater familiarity of readers with the writings of such evolutionists as Darwin and Haeckel, the word usually awakens in the mind this idea of the origin of vegetable and animal forms. It is here that the facts upon which it is founded are to be found; and it is in this department of scientific research, that the laws upon which it relies for support have been disclosed. Mr. Spencer, in discussing this branch of the subject, has grouped together a great mass of facts and laws, gathered from many different sources and verified by many observers and experimenters. These may therefore be fully accepted as ascertained truth; and a statement of the leading ones, quoted from Mr. Spencer's books, will show their real significance.

The theory being that all existing species are modifications of previously existing forms, running from man back to matter, it will be well to examine first how, and under what conditions such modifications can occur. In treating of adaptation of forms of organisms to their environment, Mr. Spencer says: "Since the function of any organ is dependent on the functions of the organs which supply it with materials and forces; and since the functions of these subsidiary organs are dependent on the functions of organs which supply them with materials and forces, it follows that before any great extra power of discharging its functions can be gained by a specially exercised organ, considerable extra power must be gained by a series of immediately subservient organs, and some extra power by a secondary series of remotely-subservient organs. Thus there are required numerous and wide-spread modifications." Mr. Spencer illustrates this fact quite fully, showing that to establish any such modifications of a part involves a modification of the whole organism, which, at best, he concludes, is necessarily a slow process and one requiring great time for its accomplishment.

Concerning the limit to which such modifications may be extended, he says: "The general truth, that extra functions are followed by extra growth, must be supplemented by the equally general truth, that beyond a limit, usually soon reached, very little, if any, further modification can be produced. The experiences from which we draw the one induction, thrust the other upon us." After somewhat fully illustrating this truth he proceeds: "Thus the general fact appears to be, that while in each individual certain changes in the proportion of parts may be caused by the variation of functions, the congenital structure of each individual puts a limit to the modifiability of every part. Nor is this true in individuals only; it holds in a sense, of the species. Leaving open the question, whether in indefinite time, indefinite modifications may not be produced, experience proves that within assigned times, the changes wrought in races of organisms by changes of condition fall within narrow limits." In view of the great difficulty of affecting such modifications at all and in the long time required at best; and in view of the fact that they are limited to the congenital structure of the individual, and in view of the fact that the same holds true of species, it seems necessary to think that the type of the race cannot change, hence that there cannot be evolution; for if the modifiability of both species and individuals is limited within the congenital structure of the individual, it is impossible to conceive how that congenital structure, which is the type of the race, can become changed.

Yet, that there may be and are, variations within the limits of the type of any race of organisms, is a fact patent to common observation and recognized by science. Mr. Spencer thus refers to it: "It seems that in each species of organisms there is a margin for functional oscilations on all sides of a mean state, and a consequent margin for structural variations; that it is possible rapidly to push functional and structural changes toward the extreme of this margin in any direction, both in an individual and in a race; but that to push these changes farther in any direction and so alter the organism as to bring its mean state up to the extreme of the margin in that direction, is a comparatively slow process.

Change of type, then, could result only from so pushing an individual organism up to this limit, and pushing those of its offspring beyond. The facts of heredity will illustrate the feasibility of this. In treating of heredity, Mr. Spencer states these facts: "First in order of importance comes the fact that not only are there uniformly transmitted, from an organism to its offspring, those traits of structure which distinguish the class, order, genus and species, but also those which distinguish the variety. We have numerous cases among both plants and animals, where, by natural or artificial conditions, there have been produced divergent modifications of the same species, and abundant proof exists that the members of any sub-species, habitually transmit their distinctive peculiarities to their descendants." Again, it seems necessary to think that if organisms habitually transmit the detailed peculiarities of their variety, as well as the greater peculiarities of their class, order, genus, and species; that there can be no modification of the type, no matter how many divergent modifications may be made, for if the typical peculiarities, as well as the minor details of the variety, are thus transmitted, it is perfectly manifest that, however many modifications may be transmitted, or however often, any change of type, under such circumstances, is wholly impossible. It is equally manifest that individual peculiarities, as well as peculiarities of the variety, cannot effect such modification, but it will be well to close the argument here, with a statement of facts from Mr. Spencer, he says: "While, however, the general truth that organisms of a given type, uniformly descend from organisms of the same type, is so well established by infinite illustrations, as to have assumed the character of an axiom, it is not universally admitted that non-typical peculiarities are inherited." Mr. Spencer, as will be seen in the quotations already made, believes that such non-typical peculiarities are transmitted, but here he shows that, while there is no dispute among biologists about the transmission of typical peculiarities, such transmission of non-typical peculiarities, by which alone evolution could be effected, is disputed. Therefore, it seems perfectly safe to think that in the face of such dispute, in the absence of universally admitted facts, showing that such peculiarities are transmitted, and with the transmission of typical peculiarities so infinitely illustrated that the fact of its occurrence has assumed the character of an axiom, there is no warrant for asserting any change of type resulting from heredity, while, as already shown, established facts show it to be impossible.

But if in view of such considerations, it were possible to conceive of such modifications being effected in the inheritance of individual variations, the question of the permanence of such changes would become an interesting one, and it may be well to examine the facts of biological science on this branch of the subject; and Mr. Spencer's Biology furnishes all that are needed. He says: "Pursuing the argument further, we reach an explanation of the third general truth, namely: that organisms and species of organisms, which, under new conditions, have undergone adaptive modifications, soon return to something like their original structures, when restored to their original conditions. Seeing, as we have, how excess of action and excess of nutrition in any part of an organism, must affect action and nutrition in subservient parts, and these again in other parts, until the reaction has divided and sub-divided itself throughout the organism, affecting in decreasing degrees the more and more minute parts, more and more remotely implicated, we see that the consequent changes in the great mass of the organism must be extremely slow. Hence, if the need for the adaptive modification ceases, before the great mass of the organism has been much altered in its structure by these ramified but minute reactions, we shall have a condition in the specially modified part that is not in equilibrium with the rest. All the remotely affected organs, as yet but little changed, will, in the absence of the perturbing cause, resume very nearly their previous actions. The parts that depend on them will consequently, by and by, do the same, until, at length, by the reversal of the adaptive process, the organ at first affected will be brought back almost to its original state. This is a somewhat elaborate explanation of the process by which a commonly observed fact is brought about. It is not a new idea to people who have had experience with either vegetable or animal life that any changes wrought in either, by culture or breeding, are speedily lost if the artificial conditions be withdrawn. It is equally true in whatever direction the modifications have been wrought, for they will soon rise from a lower state to a higher, as well as fall from a higher to a lower when natural conditions are restored. How difficult it is to effect, and what sedulous care it requires to maintain such changes, is well known both in vegetables and animals. If, then, it is so difficult, and involves so many resisted changes to effect such modifications; if they are possible only within such narrow limits, never affecting the type; if they are of such doubtful transmission to posterity, while typical peculiarities are certainly transmitted, and if they are so difficult to maintain in the individual and so easily lost, it is difficult to see how species can have arisen in the way alleged.

These facts might be held to dissipate the evolution theory in this part of nature, but there are further well established facts of science that have an important bearing upon this subject. The origin and form and composition of the germs of which all forms of life, vegetable and animal, are developed into embryos and subsequently into adult organisms, is pretty well known; and Mr. Spencer presents a fair statement of the facts so far as he uses them. He says: "The germ out of which a human being is evolved, differs in no visible respect from the germ out of which every animal and plant is evolved." Mr. Spencer follows this with a statement of the process of germ development, showing that germs, indistinguishable in character if not indentically the same, in developing, travel a little way together and separate by degrees into the myriad forms of vegetable and animal life. These germs, in their ultimate state as germs, are but nucleated cells of protoplasmic matter, a description of which is given by Mr. Spencer in an appendix to his first volume of biology. He says: "In the early world, as in the modern laboratory, inferior types of organic substances, by their natural action, under fit conditions, evolved the superior types of organic substances, ending in organizable protoplasm; and it can hardly be doubted that the shaping of organizable protoplasm, which is a substance modifiable in multitudinous ways with extreme facility, went on after the same manner. As I learned from one of our first chemists, Prof. Frankland, protein is capable of existing under probably at least a thousand different isomeric forms; and, as we shall presently see, is capable of forming, with itself and other elements, yet more intricate, compositions that are practically infinite in their varieties. Exposed to those innumerable modifications of conditions which the earth's surface afforded, here in the amount of light, there in amount of heat, and elsewhere in the mineral quality of its aqueous medium, this extremely changeable substance must have undergone, now one, now another, of its countless metamorphoses."

This is a brief, but adequate statement of most important scientific facts. It brings to view the character of protoplasmic matter, from which the primordial cells from which all living organisms, vegetable and animal, spring; and of which they are chiefly composed. It shows us that it can be, and now is, produced in laboratory, which warrants Mr. Spencer's induction, that during the period in which things were being formed, the conditions of the laboratory were more than fully realized in nature, for the laboratory has not yet demonstrably developed protoplasm into an organism, while nature has. It shows the exceeding modifiability of this matter and its susceptibility of being developed into all most infinite forms of organisms and it warrants the conclusion that it was formed in the great laboratory of nature, over a long period of time, and under many various conditions, and hence would most likely be developed into many varieties of organisms, instead of one primordial form from which all others were subsequently evolved. It gives also the history of all living forms, from organic matter up to the germs, and the history of the germs, through the embryonic stages has just been noticed.

Here arises the question, by what agency has inorganic matter been thus developed into organic matter, then into protoplasm, then into germs, then into embryos, and then into adult individuals? Mr. Spencer attributes this work to force, which as expressed in motion he says follows the line of least resistance. Here recall the facts already quoted concerning the great difficulty of effecting changes in developed organisms, and the extreme modifiability of protoplasmic matter, and the question as to which appears the line of least resistance can be answered only in one way, which is unfavorable to the evolution theory. The unfailing transmission of the typical peculiarities, it has already been shown, makes the origin of species, in the way alleged, inconceivable; and it is seen that the character of protoplasm and the law of force show quite a different origin from that alleged. The creation theory as it is presented in the Bible, contemplates that all species had a common origin in the great laboratory of nature. Science, as formulated by the evolutionists, shows that this common origin was in protoplasm. It shows also that the origin of the individual is, and always have been, in this element, the laboratory of nature being confined, subsequent to the formation of organisms, to the bodies of the organisms. Evolution breaks this order of nature in assuming one origin for the individual and a different one for the species.

The next question that presents itself for consideration is, why do protoplasmic cells, indistinguishable from each other, develop into such varied forms, and always in the same form as the parent organisms? Mr. Spencer offers an explanation of this phenomenon, but it is too long for quotation. It is to the effect that protoplasmic matter is composed of molecules, each of which is constructed of many atoms; and that the complexity of the molecules arising from such formation is attended with a like complexity of polarity, which gives to the cell germs a tendency thus to develop in a certain way. This, it must be observed, is a theory based upon several other theories. In the first place, the atomic constitution of matter is a theory; and the polarity of such atoms is also a theory; both of which appear to be true, but neither of which has been demonstrated by experiment. To these Mr. Spencer adds the additional theory that these atoms are unlike, and that their polarity is unlike; for in no other way could their combination produce a complex molecule, or their polarity thus combined constitute a complex polarity. This assumed unlikeness of atoms, and of polarity of atoms, is unaccounted for. It is not embraced in his definition of evolution—and integration of matter and a dissipation of motion—for it is an integration of something else than matter—an integration of polarity. These complex molecules he calls "Physiological Units." From what has already been said of them, it would seem that they rest upon a very doubtful basis; but if this weakness be overlooked, and their existence and adequacy be conceded, it will be found that other and greater difficulties are encountered. If it be conceded that there are such units, and that to their existence is due the tendency of matter to grow into certain defined forms, the mystery is removed one step further back, and there occurs the question, why does organic matter form itself into such complex units? If this be accounted for by the same principle, which it seems must be done, because all the laws of evolution are general and, with appropriate modification, apply alike to all parts of the process, the mystery is again removed, and the question occurs: why does inorganic matter have a tendency to form itself into organic matter? This question cannot be answered by the same principle, for there is no form of matter behind the inorganic form. These physiological units, therefore, appear to lead to an unanswerable question, and explain the fact in explanation of which it is offered, only by a removal of the mystery supposed to be explained.

If, then, the only theory advanced by Mr. Spencer to explain this phenomenon, which lies at the foundation of all animal and vegetable forms, fails to explain it, it is safe to assume that an explanation must be sought elsewhere. In a recent paper on the "Unity of Nature," it is referred to the Duke of Argyll, whose book on "The Reign of Law" sufficiently establishes his standing as a scientist and thinker. He says: "There are structures in nature which can be seen in the process of construction. There are conditions of matter in which its particles can be seen rushing, under the impulse of invisible forces, to take their appointed places in the form which is to them a law. Such are the facts visible in the process of crystallization. In these we see the particles of matter passing from one 'molecular condition' into another; and it is impossible that this passage can be ascribed either to the old arrangement, which is broken up, or the new arrangement which is formed in its stead. Both structures have been built up out of elementary materials by some constructive Agency which is the master and not the servant—the cause and not the consequence of the movements which are effected, and of the arrangement which is the result. And if this be true of crystalline forms in the mineral kingdom, much more is it true of organic forms in the animal kingdom."

In some form and under some name all creeds and philosophies have recognized this Agency in nature. It lies below the forms and laws of nature. As such every science recognizes it and knows it by its methods of working, which constitutes the laws of science. That it is a unity there is no longer a doubt, for it is found all sciences harmonize with each other, and classifications in nature are not sharply definite but arbitrary distinctions made for the convenience of knowledge. Of its limitation in space, if it have any, man can gain no information; for it shapes not only all earthly forms, inorganic and organic, but it shaped the earth itself, and the stars, and systems of stars, and binds them together in unity and harmony of movement. A place in nature where it is not is inconceivable; it is the author of all phenomena. Wherever phenomena occur, there it is present and at work. It penetrates and permeates all things. It has been observed of the ether, that it is so subtile that it might float through the most solid substances with the ease with which air floats through a grove of trees; but this Agency is so much more subtle that it penetrates the ether and gives it its vibratory power. It is the same that the atheist has called the "potentiality of matter," and that Mr. Spencer calls unknowable force.

Since it is such Agency that breaks up and forms combinations of matter, what must reason conceive to be its character? The structures it forms are of definite construction and adapted to the performance of definite functions, which thrusts upon us the induction of design and purpose. Design and purpose, and the form of the structure through which they are expressed anterior to its formation, can be only conceptions in a thinking mind. Their enforcement through a material structure can be conceived only as an expression of will. And it is manifest that forms cannot be thus constructed in a definite way and for a definite purpose by a constructive Agency that is not conscious of the purpose and design and the structure, which implies that this Agency is possessed of what man has called feeling. These qualities constitute personality, which shows that this agency in nature, apprehended by science, is the same as had been previously apprehended by religion and worshiped under the name of God. However it may be defined, and by whatever name it may known, the mind necessarily ascribes to it the same qualities, the same characteristics and the same functions in nature. It rules and guides the universe, and is the power that gives it action. It is not in physics alone that it is apparent, but its hand is perceptible also in the world of morals and of mind. Ever present everywhere, the movement of an atom or a world, the slightest shade of thought and feeling or the most momentous events are alike matter of its knowledge. There is no abyss of darkness and mystery between it and man. Little as man knows of its infinite ways, it is nevertheless as much a present reality as himself. It is his constant companion in his joys and sorrows, in his trials and triumphs, and in his beneficiencies and his crimes; and, doubtless, conscious of many of his motives of which he takes no cognizance himself. It requires of him obedience to the laws of his own being as the condition of his highest happiness, and has affixed to disobedience the penalty of pain.

ASTRONOMY.

A NEW CHRONOGRAPH.

BY THE EDITOR.

Mr. W. W. Alexander, of this city, has in use a chronograph, of his own design and construction, by the use of which he is enabled to determine the time of a star's passage across the meridian, or, more exactly, across the five vertical wires of his transit, and to note the time the star is bisected by the wire, to the tenth or the hundreth part of a second by merely pressing a spring.

The principle is as follows: A round disk of paper, placed upon a horizontal block of wood four inches in diameter, is made by accurately running clock-work to turn around once in a minute of sidereal time, or nearly so, (a slight variation may be corrected). A needle point is arranged at a short distance above the moving disk, which simultaneously with the pressing of the spring, makes a hole in the paper and readjusts itself in position in less than the hundredth part of a second. At each round of the disk, the needle point moves in toward the center of the paper the sixteenth part of an inch, which prevents confusion in distinguishing the punches. To illustrate its use, take the following example:

Suppose an occultation of a star by the moon, or an eclipse (the time of which is desired to be known) takes place at about 8 h. and 5 m. Then at five or ten minutes before that time, arrange and place the disk of paper in position and start the Chronograph running; then observe by a standard clock or chronometer the end or beginning of some exact minute; then touch the spring, which marks the paper; then go to where the observation is to be made, and simultaneously with the occurrence again press the spring, and another mark is left on the paper disk. Then remove the disk and place it on the reading dial, which will show, by the relative positions of the marks, the interval from the time of the first mark made to the one made at the time to be noted, to the tenth or one hundredth of a second. In this case suppose it showed 4 m. 12.7 s.; add this to the time of the first mark, 8 h. 1 m., which gives 8 h. 5 m. 12.7 s., the time by clock or chronometer at which the occurrence took place. Then by knowing the error of the clock or chronometer, from previous observations with the chronograph and transit, the observation may be made exactly correct, in time, by adding or subtracting this difference (*i. e.* aside from personal equation).

Another feature in its favor is this, that the marks on the disk are permanent, and can be preserved and read at leisure, thus obviating the necessity of using bright lights for night work and careful scrutiny of delicate lines and points at the instant of observation.

Mr. Alexander is a close and careful observer, and invented this instrument merely for his own use and convenience, but on account of its simplicity, durability and accuracy, it will doubtless be found so highly useful as to be speedily adopted by other astronomers.

THE SUN AND PLANETS FOR JANUARY, 1881.

BY W. W. ALEXANDER, OF KANSAS CITY.

The Sun on the 1st culminates or passes the meridian at 00 h. 4 m. 6.82 s., at an elevation of 27° 57′, and on the 31st at 00 h. 13 m, 47.31 s., at an elevation of 33° 42′.

The sidereal time of mean noon on the 1st is 18 h. 46 m. 07.97 s., and on the 31st 20 h. 44 m. 24.69 s.

Mercury on the 1st will culminate at 11 h. 2 m., a. m., at an elevation of 27° 07′, and on the 31st at 00 h. 33 m. p. m., at an elevation of 32° 56′. On the 26th it is in superior conjunction with the Sun.

Venus on the 1st will culminate at 2 h. 57 m. p. m., at an elevation of 35° 23′, and on the 31st at 3 h. 07 m. p. m., at an elevation of 49° 56′. Its apparent diameter on the 1st is 16″, and on the 31st 20″. It is fast increasing in apparent size and brilliancy.

Mars on the 1st will culminate 10 h. 33 m. a. m. at an elevation 27° 26′, and on the 31st at 10 h. 12 m. a. m., at an elevation of 27° 25′. It is quite small and hard to see, but is slowly enlarging.

Jupiter on the 1st will culminate at 5 h. 55 m. p. m., at an elevation of 54° 05′, and on the 31st at 4 h. 12 m. p. m., at an elevation of 55° 46′. It is slowly decreasing in size and splendor.

Saturn on the 1st will culminate at 6 h. 38 m. p. m., at an elevation of 57° 13′, and on the 31st at 4 h. 45 m. p. m., at an elevation of 57° 48′. Its rings are again slowly opening out to view, but its size and brilliancy is decreasing.

Uranus on the 1st will culminate at 4 h 16 m. a. m., at an elevation of 58° 04′, and on the 31st at 2 h. 15 m a. m., at an elevation of 58° 22′.

Neptune on the 1st will culminate at 7 h. 51m p. m., at an elevation of 64° 32′, and on the 31st at 5 h. 53 m. p. m., at an elevation of 64° 33′.

The Moon on the 1st culminates at 1 h. 16 m. p. m., and on the 31st at 1 h. 44 m. p. m. On the 3d it is a little south of Venus, and on the 6th and 7th it is a little north of Jupiter and Saturn, and on the 27th it is very close to Mars.

BOOK NOTICES.

REPORT OF THE COMMISSIONER OF EDUCATION FOR THE YEAR 1878: Hon. John Eaton, Commissioner. Government Printing Office: 1880; pp. 730, octavo.

We have heretofore referred to the work accomplished by General Eaton as most valuable and useful in matter as well as creditable in form, both to the Government and to himself, and we can only at present repeat this conviction, though an abstract of the volume before us would be far more satisfactory, had we the space for it.

The sources of information from which the matter of the Report is derived are Reports from States, Territories, and cities, from schools of all classes, and from all other institutions of an educational character, as libraries and museums. This material has increased more than eight-fold since 1870. To this must be added the foreign material, reports and periodicals which are examined and the most important information they contain summarized by the translator.

The Report is full and comprehensive, including information on almost every point connected with the education, not only of the children of each State, but of its teachers, its deaf and dumb, and blind, its medical, theological and law students; also its libraries, educational benefactions, its colleges and universities, schools of science, and the educational publications and patents. Following this is an account of education in foreign countries, and finally of the representation of education in the United States in the Paris Exposition of 1878, where 121 premiums were taken as awards in various classes, besides a gold palm to Gen. Eaton, the cross of the Legion of Honor to Dr. John D. Philbrick, the superintendent, and three silver palms to Messrs. Harris, Kiddle and Wilson, being nearly one-sixth of the whole number of awards made in this department of the Exposition. This shows how highly the world regards the school system of the United States.

THE RHYME OF THE BORDER WAR: By Thomas Brower Peacock. New York: G. W. Carleton & Co, 1880, pp. 162, 12 mo, $1.00.

This is a handsomely printed volume, by a gentleman of Topeka who has already acquired a fair reputation as a writer of poetry. This reputation will be in no wise lessened by his latest effort, which contains many genuinely poetic fancies and lofty passages. The introductory lines are especially good, and many of the descriptions of scenery and character are finely conceived and delicately portrayed. Among these we can only take time to mention the Poet and Song which abounds in such gems.

The poem will doubtless meet with a better reception in localities more remote from the scenes of the events described than in their vicinity, since it will be almost impossible to arouse any enthusiasm in the minds of those who participated in them or of those who knew the outlaws that are made prominent in this book, on either side, regarding their characters or deeds. Civil war is not the most exalted theme for the poet, at best, and the warfare of this Border lacked nearly all the elements of true poetry. Still, we must give Mr. Peacock credit for having made the most of his material and for having much of the imagination and descriptive power that belong to the poet. Experience and cultivation of his naturally fine qualifications will correct the defects in versification common to all young writers, and we may expect to see him, in riper years, attain an enviable position among western authors.

On the Origin of Species: By Thomas H. Huxley, F. R. S., F. L. S., pp. 26, Quarto. J. Fitzgerald & Co., New York, 1880, 15c.

This re-print of the six lectures of Prof. Huxley, on the causes of the phenomena of organic nature, makes up Number Sixteen of the well-known and popular Humboldt Library. No more interesting lectures were ever delivered, and whether one agrees with the author in all of his conclusions or not, he cannot help being attracted and instructed by the graceful style and multitude of facts presented.

To those who want such works in a cheap form, the Humboldt Library offers a tempting prize.

OTHER PUBLICATIONS RECEIVED.

Annual Report and Statistics of the Meteorology and Mortality of the City of Oakland, California, by J. B. Trembly, M. D.; Longevity, No. 15 Humboldt Library series, J. Fitzgerald & Co., New York; Abridgement of the Nautical Almanac for 1881, Riggs & Bro., Phila.; Maritime Meteorology, by Thompson B. Maury, Phila.; Quarterly Botanical Index, L. B. Case, Richmond, Ind.; Anthony Republican, A. S. Lyndsay, Anthony, Ks.; Weekly Herald, Dr. Stephen Bowers, Clinton, Wis.

The *Literary News*, published by F. Leypoldt, New York, will be found a most useful periodical to all persons desirous of keeping up with the literary progress of the day, or who require assistance in building up either private or public libraries.

METEOROLOGY.

METEOROLOGICAL OBSERVATIONS AT WASHBURN COLLEGE TOPEKA, KANSAS.

PROF. J. T. LOVEWELL.

From November 20 to December 20, 1880, the period embraced in this report, has been characterized by a continuance of the cold, dry weather which prevailed in the first twenty days of November. By reference to the tables below, it will be seen, that during the last ten days the temperature has averaged more than ten degrees higher than in the two decades previous. The relative humidity has also been greater and the barometric pressure lesss The temperature has fallen below zero but once—December 6th, when it was –03°. This followed the night after a violent gale of wind which blew from the NW. for five hours, with a velocity of nearly fifty miles per hour. The same storm brought snow in many other places further east and north. Snow has fallen here on three days: November 24th and 25th and December 16th. Not more than one inch remained on the ground at one time. The highest temperature reached was 61°, on December 13th. The greatest pressure was, reduced to sea-level and 32° F., 30.68 inches, Nov. 21st; the lowest was 29.32 inches, December 4th, preceding the gale mentioned above.

The rain-fall has been very light but the air has been moist, especially during the last ten days, preventing excessive evaporation. Ice has formed abundantly on the river and a large supply is being gathered for the ice houses.

The miles traveled by the wind has been more than one thousand less than the previous month, and on the day before the gale, December 4th, the total number of miles traveled was but seventy-four, the smallest distance in one day recorded by the anemometer since it was set up last May.

RECORDS DEDUCED FROM AVERAGES OF DAILY OBSERVATIONS.

	Nov. 20th to 30th.	Dec. 1st to 10th.	Dec. 11th to 20th.	From Nov. 20 to Dec. 20.
TEMPERATURE.				
Min.	12.9	12.3	26.7	17.3
Max.	26.6	33.4	44.0	34.7
Mean.	19.7	21.8	35.1	25.5
Range.	13.6	22.2	17.6	17.8
7 a. m.	13.2	12.8	28.6	18.2
2 p. m.	24.5	31.2	39.6	31.8
9 p. m.	18.4	19.9	31.7	23.3
Mean	19.8	22.4	32.8	25.0
REL. HUMIDITY.				
7 a. m.	.52	.70	.77	.66
2 p. m.	.59	.77	.67	.68
9 p. m.	.54	.70	.69	.64
Mean	.55	.71	.72	.66
PRESSURE, sea-level, 32° F.				
7 a. m.	30.40	30.25	29.28	29.98
2 p. m.	30.32	30.16	29.92	30.13
9 p. m.	30.30	30.18	29.86	30.11
Mean	30.37	30.20	29.97	30.15
WIND.				
Miles Traveled	2,533	2,937	3,611	9,081
RAINFALL.				
Inches	0.25	....	0.05	0.30

SCIENTIFIC MISCELLANY.

GENERAL WILLIAM B. HAZEN.

General Hazen, the newly appointed successor to the late General Myer as Chief Signal Officer of the army, was born in Vermont, appointed a cadet at West Point from Ohio, and is now a little more than fifty years of age. His original entry into the army was in 1855, as Brevet Second Lieutenant of the 4th Infantry. He was made Captain in the 8th Infantry in May, 1861. At the commencement of the War of the Rebellion he was on duty at West Point as an instructor in Infantry Tactics, which position he gave up to accept the Colonelcy of the 41st Ohio Volunteers in November, 1861. His distinguished services caused his rapid promotion, being placed in charge of a brigade early in January, 1862, and appointed Brigadier General of Volunteers in November, 1862. He was highly complimented for his ability and gallantry at Murfreesboro by General Rosecrans, and afterward, for similar services at Chicamauga and Chattanooga, by General Thomas. In April, 1865, he was commissioned Major General of Volunteers "for long and continued service of the highest character and for special acts of gallantry and service at Fort McAllister."

Since the war he has continued to serve his country as Colonel in the regular army, and has written several works as the results of his observations at home and abroad. After his return from Prussia, where he accompanied the army in the campaign against France and was present with it during its investment of Paris, he wrote "The School and the Army in Germany and France," in which he gave the credit of the superiority of the German soldiers to their thorough training in the public schools of their country. Later he published a report on the "Barren Lands of the Interior of the United States," besides numerous magazine articles at different times. His confirmation was made by the unanimous vote of the senate, and it is the universal verdict of the press, so far as we have seen that the appointment was one of the best that could have been made from the regular army.

A writer in a London paper, in discussing the photophone, says: The problem which Prof. Bell has attacked is that of the transmission of speech, not by wires, electricity or any mechanical medium, but by the agency of light. The instrument which embodies the solution of this problem he has named the photophone. It bears the same relation to the telephone as the heliograph bears to the telegraph. You speak to a transmitting instrument which flashes the vibrations along a beam of light to a distant station, where a receiving instrument reconverts the light into audible speech. As in the case of that exquisite instrument, the telephone, so in the case of the photophone, the means to accomplish this end are of the most ridiculous simplicity. The transmitter consists of a plain silvered mirror of thin glass or mica. Against the back of this flexible mirror the speaker's voice is directed. A powerful beam of light is caught from the sun and directed upon the mirror so as to be reflected straight to the distant station. This beam of light is caused by the speaker's voice to be thrown into corresponding vibrations. At the distant station the beam is received by another mirror and concentrated upon a simple disk of hard rubber, fixed as a diaphragm across the end of a hearing tube. The intermittent rays throw the disk into vibration in a way not yet explained, yet with sufficient power to produce an audible result, thus reproducing the very tones of the speaker. Other receivers may be used, in which the variation in electrical resistance of selenium under varying illumination is the essential principle. Other substances beside hard rubber—gold, selenium, silver, iron, paper, and notably antimony—are similarly sensitive to light.

POPULATION OF THE GLOBE.

According to "*Die Bevolkerung der Erde*," published by Messrs. Behm and Wagner, Europe has a population of 315,929,000 inhabitants; Asia has 834,707,-000; Africa has 205,679,000; America, 95,495,000; Australia and Polynesia, 431,000; the Polar regions, 82,000, which give altogether a total of 1,455,923,-000, an augmentation of 16,778,000 over the last known census. At the close of 1877, Germany reckoned a population of 43,943,000; Austria and Hungary, in 1879, estimated 38,000,000; Great Britain and Ireland, in 1879, 34,500,-000; and France, in 1876, 36,900,000; Turkey in Europe, 8,860,000; and the Russian Empire, 87,900,000.

China has in Asia, in all her dependencies, an extent of 11,814,000 square kilometers, on which there are 434,600,000 inhabitants; Hong Kong has 139,-144 inhabitants; Japan, according to the official census of 1878, had 34,300,000 inhabitants. The English possessions in India have a population of 240,200,000; the French possessions in India have 280,000 inhabitants; Cochin China has 1,600,000 inhabitants; Chinese India has 36,900,000; the East India islands have 34,800,000; and the islands of Oceanica, 879,000.

According to Dr. Nachtigal, Africa has an extent of 26,283,000 square kilometers, which are thus divided: Forests and uncultivated lands, 6,300,000 square kilometers; plains, 6,225,000 square kilometers; deserts, 10,600,000 square kilometers; steppes, 4,200,000 square kilometers. The English possessions in North America have a population of 3,800,000; the United States have 48,500,000; and Mexico has 9,485,000; and Brazil has 11,100,000. As to the Polar regions, they have an extent of 3,859,000 square kilometers around the Arctic circle, and are scarcely inhabited, except in Iceland, where there are 72,000 inhabitants, and in Greenland, where there are 10,000 inhabitants. The Antarctic regions have an approximate extent of 660,000 square kilometers.—Translated from "*L' Exporation*" by J. F.

The *Electrician* tells this story: A number of gentlemen were the other day about to dine, and one of the dishes was especially cared for, containing, as it was seriously averred, a "gymnotus," fresh from the rivers of South America, which was to form a part of the repast. Usually, electricians scrupulously observe decorum, but the chairman, instead of pronouncing the benediction, turned to the dish containing the eel and solemnly requested grace, when, with a sweet cadence, as if from a mermaid in cavernous regions, was heard all over the place, "Be present at our table, Lord," etc. The cover was then raised, and the anticipated electric eel turned out to be a telephone which had been ingeniously connected to a distant room, and which, being a religiously good telephone, not only produced a pleasing sensation to all present, but afterward returned thanks in a powerful but well-known voice to the admiring listeners.

THE GULF STREAM.

The papers read before the National Academy of Sciences yesterday were of much more general interest than most of those read on Tuesday. The morning session was devoted to reading and discussion of two contributions upon allied topics, "The Basin of the Gulf Stream," by Prof. J. E. Hilgard, and "The Origin of the Coral Reefs of the Yucatan and Florida Banks," by Prof. Alexander Agassiz. Recent surveys under Superintendent C. P. Patterson, of the United States Coast and Geodetic Survey, show that fully one-third of the Gulf of Mexico is less than 100 fathoms deep, the depth increasing very rapidly at about the 100-fathom line to a flat central basin, about 2,000 fathoms in depth. The two large plateaus, less than 100 fathoms beneath the surface of the water, are along the west coast of Florida, about 130 miles broad, and to the north of Yucatan, about 100 miles broad. These plateaus show the actual continental outline to be very different from the shore lines of the Gulf. Prof. Agassiz, in his paper, showed that these plateaus, whatever may have been their primal origin, are very largely composed of limestone, formed of the osseous carcasses of submarine life, and that whereas they had been in this way built up to the depth at which coral atolls or reefs begin to form—twenty-seven fathoms—as in the case of the Florida Keys and the coral islands north-west of Yucatan, coral atolls exactly similar to those in the Pacific described by Darwin were found. But Darwin had explained the Pacific atolls by a gradual, general subsidence of the bed of the ocean, and his theory was that all reef formations were accompanied by subsidence. Here in the Gulf the formation accompanies an elevation, and as similar plateaus are found in the coral regions of the Pacific, it is concluded that Darwin was all wrong, and that coral reef formations accompany elevations of ocean beds, instead of subsidence. During the discussion, the interesting fact was developed that the Gulf Stream, so called, does not come from the Gulf, as is represented in the physical geographies, but is an equatorial current which comes through the Caribbean Sea from the African coast, is turned north-east upon striking the coast of Yucatan, passes through the Straits of Yucatan and Florida and out into the Atlantic, without really entering the Gulf of Mexico at all. The currents in the Gulf are not connected with this great stream, and are very slow. The mouths of the Mississippi have already projected so far beyond the general coast line as to have nearly reached the precipitous declivities of the deep Gulf Basin, so there is no danger that the channel will ever be stopped again, or that the jetty system will have to be extended further into the Gulf than at present.—*N. Y. World.*

A California inventor has devised a process for pressing and drying potatoes so that they will keep for years without loss of flavor.

THE PREHISTORIC CAT.

The editor of the *Industrialist*, published at the Agricultural College of Kansas, gravely makes the following "forecast": "The December number of the *American Naturalist*, it is announced, will contain an article, 'copiously illustrated,' on the 'Extinct Cats of America.' We shall await the appearance of this number of the *Naturalist* with intense interest, feeling confident that this 'leading article' will lead to the solution of one of the great problems of science. Reasoning *a priori*—that surest road to truth in natural science—it must be plain to the dullest intellect that, where the 'extinct cat' is found, there will also be numerous billets of wood and boot-jacks, and possibly an occasional soap dish; and that all will be found in the neighborhood of a 'back fence,' we cannot for an instant doubt. Again, that a fossil bedroom window will be found near this back fence, opening upon it, we as surely believe as that the 'extinct cat' was ever a live one. Fortunately, science disdains not the meanest object of study, and to it we commend this bedroom window, leaving it wide open, so to speak, and feeling confident that near it will be found the *prehistoric man*, if not the 'missing link' itself."

The one unfortunate thing in house decorations nowadays, in the opinion of Mr. R. W. Edis, is the everlasting seeking after some novelty in papers, curtains, or other hangings. Everybody wants to have a room different from her neighbor. Decoration is being done as a fashion, not from any real love of it. Of course, we should not like to see room after room repeating itself in decoration, but why a few really good papers should not be the ground-work of true artistic decoration—when the narrowness of worldly circumstances prevents the more elaborate and more expensive hand decoration in paint or distemper—and let the rest follow from the design, there is no good reason. If that suggestion should be adopted, there might be hope for real art decoration instead of the cold formality and everlasting interchange of two or three colors. As a critical writer on art decoration has said: "If the papers on our walls and the curtains we hang in our rooms were, even at second hand, but the record of the fresh impressions and the graceful fancies of artists of our own day instead of being incumbered with mechanical pattern work struggling to be artistic, it would be better than all the present miserable striving after novelty." Not to have what your neighbor possesses is the bane of decorative art.

Celluloid Veneer is gaining favor as an ornament for furniture. As an imitation marble or malachite top for tables it shows most admirable fitness, and for panels in imitation of tortoise shell, etc., it is a handsome addition for chamber sets.

EDITORIAL NOTES.

SUBSCRIBERS to the REVIEW can obtain any book or periodical published in this country or Great Britain, or the publications of any of the prominent publishers of the United States, at reduced rates, by applying at this office.

A most important bill has just passed both houses of Congress, appropriating all the proceeds derived from the sales of public lands hereafter, to educational purposes. For the first ten years the funds are to be distributed on the basis of illiteracy, after that on the basis of population. The bill devotes thirty per cent to the higher education. Congress passed the bill without dissent, and it will undoubtedly become a law as it is in full accord with the genius of the American people and the spirit of the age. And there is true wisdom shown in carrying forward the higher and common school education *pari passu*, as they are mutually dependent on each other—the common schools sending forward students prepared for the higher grades, while the colleges and training schools return text-books and teachers.

THE Royal Geographical Society is considering the advisability of fitting out another Arctic expedition, not, however, with the design of making another attempt to reach the North Pole. It is to be devoted to an examination of the accessible polar regions, in the interest of science, and for the elucidation of certain questions in the physical geography of the globe.

THE Emperor William, of Germany, has been, during the last year, earning the gratitude of the archæologists. He has defrayed from his own private purse the expenses of the excavations at Olympia.

A MONSIEUR LOITEL has been recently dredging in the Sea of Galilee. It has a depth of 800 feet and contains twelve species of fish. The majority of these species have the singular habit of hatching their eggs and sheltering their young in their mouths.

DR. JNO. RAE, F. G. S., the noted Arctic explorer of England, says in a note dated Nov. 11, 1880, "I read many articles in your REVIEW with much pleasure."

ITEMS FROM THE PERIODICALS.

THE *Atlantic Monthly* numbers the ablest and best American writers among its contributors.—Longfellow, Whittier, Holmes, Lowell, Stedman and other renowned poets; Mrs. Stowe, Howells, Aldrich, James, Bishop, Rose Terry Cooke, Miss Woolson and other admirable writers of novels and short stories; W. W. Story, Norton, Warner Waring, and other skillful writers of travel and foreign life; Whipple, Fiske, Perry, Miss Preston and other careful and discriminating critics.

Since January, 1880, *The Atlantic* has been printed in new and larger type, on a larger page, and each number increased to contain one hundred and forty-four pages.

The number for February, will have an interesting and important article on German Credit-Unions, and a noteworthy paper on American Shipbuilding. Mr. John Fiske will contribute the first of his essays on our Aryan Ancestors; and Major Ben. Perley Poore an interesting chapter of his Reminiscences of Washington. There will be installments of Miss Phelps's and Mr. James's stories, and a short story, with the usual variety of essays, criticisms and poems.

THE *Manufacturer and Builder*, of New York, enters upon its thirteenth volume with the January number, and, under the editorship of Prof. W. H. Wahl has become one of the best journals of the class in this country. Monthly, 24 pages quarto, $2.00 per annum.

THE sixty-second Volume of *Harper's Magazine* began with the December Number. The February Number will contain an able paper. by the Rev. HENRY J. VAN DYKE Jr., on the Gospel History in Italian Painting, with a large number of fine illustrations; the conclusion of MONCURE D. CONWAY'S "The English Lakes and their Genii," with illustrations by ABBEY and PARSONS; a second paper on the Old New York Volunteer Fire Department, by G. W. SHELDON, illustrated; an illustrated article on Pottery in the United States; a paper entitled "Literary and Social Boston," by GEO. P. LATHROP, with eighteen illustrations; the third part of Miss WOOLSON'S serial story, "Anne," with an illustration by REINHART; the second part of THOS. HARDY'S new novel, "A Laodicean," (published exclusively in *Harper's Magazine*,) with an illustration by DU MAURIER; a paper entitled "The Early History of Charles James Fox," by the Hon. JOHN BIGELOW, a characteristic Georgia sketch, "Puss Franklin's Defense," by R. M. JOHNSTON; and other interesting reading-matter---poems, short stories, etc.

GOOD COMPANY, Number Fifteen, has an account of a steamboat trip to the head of navigation on the Missouri river by Mr. Herbert Hall Winslow, which happily contains information and incident, and is not wanting in graphic description of scenery and experiences with Indians, etc. in that little-known region of our vast Northwest. One of the novel and characteristic occurrences on the trip was a free fight among some of the steamboat hands.

Apropos of Dora d'Istria's recent visit to the United States, the story of that most remarkable woman's life is given. Mrs. M. S. Bull writes of the noble philanthropist Gerrit Smith.

There is an account of the origin and growth of the United States Life-saving Service, including some vivid descriptions of its members' experiences with wrecks; a paper on Eskimo traditions; an account of the Chinese professor and his family at Cambridge; and "Autumn Leaves," by E. S. Gilbert.

For fiction there is an installment of Ellen W. Olney's serial and several complete stories.

One or two shorter articles, with poems and the department of "Discussion and Suggestion," fill out the number.

WE learn from the New York *Observer* that Principal Dawson of McGill College, Montreal, delivered a course of lectures last month to the students of Auburn Theological Seminary, on the "Geological Features of Bible Lands, Illustrative of Bible History." The special topics embraced in the six lectures were: "Parallelism of Geological Chronology;" "Early Bible History;" "Geology of Egypt in Relation to the Hebrew Sojourn;" "The Sinaitic Peninsula and the Exodus;" "General Geological Structure of Palestine;" "The Dead Sea and its Geological History;" "Pre-historic Palestine–General Conclusions."

PROF. ASAPH HALL continues his articles upon the Advance of Astronomy, in the *Observatory;* also Prof. C. A. Young, of Princeton, who contributes an article upon the Spectrum of Hasting's Comet.

No magazine published in the United States has made more brilliant progress within the past few years than the *North American Review*. It enters on its sixty-sixth year with the January number, which is full of excellent articles by some of the ablest writers of the present day in America. Its contents are as follows:

"The Philosophy of Persecution," by Prof. JOHN FISKE; "Controlling Forces in American Politics," by Senator GEO. F. EDMUDES; "Atheism in Colleges," by JOHN BASCOM, D. D., LL. D., President of the University of Wisconsin; "The Ruins of Central America," Part V., by DESIRE CHARNAY; "Partiran Government," by WM. D. LE SUEUR; "Popular Art Education," by Prof. JOHN F. WEIR, Director of the School of Fine Arts, Yale College; "The Limitations of Sex," by NINA MORAIS; "The Mission of the Democratic Party," by Senator WM. A. WALLACE; "Recent Philological Works," by Prof. F. A. MARCH.

MR. WILLIAM FARNELL in a short article in the *American Microscopical Journal* denies that the *Drosera brevifolia* and the *Saracenia varioloris* are insectivorous plants, claiming that he has gathered them at all proper seasons and never found any insect caught in the first, and that whenever he found any remains of them in the second he invariably found at the bottom of the tube a white worm with strong black mandibles, which was evidently the insectivore.

THE *Scientific American*, for Dec. 25, has a communication from Andrew Van Bibber, combating the popular idea that rain always follows heavy cannonading, and giving several instances in his own experience, for instance, at the battles of Shiloh, Corinth, Lookout Mountain, and Missionary Ridge, where no rain followed the heaviest artillery explosions.

We give a table showing the coldest day of December in each year since 1875.

			7 a m.	2 p m.	10 p m.
1875	Dec.	17	–2	11	9
1876	"	29	–4	4	–3
1877	"	1	10	29	24
1878	"	25	–4	7	3
1879	"	24	–7	2	–7
1880	"	28	–6	–2	–10

THE subcutaneous injection of sulphuric ether in three-drop doses, at intervals of twelve hours, is recommended by Dr. Comegys for the successful treatment of sciatica; and he thinks that the substitution of ether for ergotine in dealing with tic-doloreux would give good results.

THE weather for the last few days of December was remarkably cold. On the 28th at Chicago, the mercury fell to —18°, at St. Louis to —10°, at Minneapolis —28°, at Fort Garry —41°, at St. Paul —25°, at La Crosse —20°, at Milwaukee —19°, at Leavenworth —16°, at Kansas City —10°.

MR. Frank Buckland, the well-known naturalist and pisciculturist, is suffering from a severe attack of dropsy, and now lies in a very critical condition.

THE December meeting of the Kansas City Academy of Science was held on the 28th ultimo, and there was a good attendance notwithstanding the extreme coldness of the weather. Mr. W. H. Miller read his third paper on the Synthetic Philosophy of Herbert Spencer, which was well received by the Academy, and is published in this number of the REVIEW.

Col. R. T. Van Horn read a paper on "A New Hypothesis of Life," in which he took up and treated the radiant form, or fourth form of matter, suggesting that possibly this form of matter might present the primordial environment and conditions of life, of whose origin, science so far has made no revelations. There is no physical basis of life, material forms only giving its conditions and environment. The paper was original, fresh and cogent, but as it will appear in the February number of the REVIEW in full, we will attempt no abstract of it now.

PROF. J. S. Newberry, an unquestioned authority on the subject, said in a recent address before the National Academy of Sciences that the quantity of iron in Utah is such as to throw into the shade all other known deposits in this country.

OF late the electric light has been employed by naturalists to attract insects, which they desire to collect for examination or to preserve as specimens.

Geological explorations have shown the probability that Russia contains beds of phosphate of lime of sufficient extent, to supply Europe for an indefinite period.

PROF. Strasburger, of Jena, holds that the attributing of all the functions of life to protoplasm, is to be looked upon as a great advance in science, although it is impossible thus far even to form hypotheses with regard to the forces which are at work in the protoplasm.

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PHILOSOPHY.

THE NEW HYPOTHESIS.

BY HON. R. T. VAN HORN, KANSAS CITY, MO.

The mind of man is so constituted that it is not content with mere formula, but is always searching for facts. Each new discovery is but a point of departure in the ultimate inquiry, whence are we? And while this question has been the one of all ages and of all research, it remains unanswered. It is unlike that other universal question: "If a man die shall he live again?" the answers to which are as voluminous as religions and supernatural literature. Upon this question rests the ecclesiastical structures of the world in all ages, as well as the occult teachings of the mystics of every degree in all time. Its affirmation is woven into all systems of jurisprudence and underlies the laws of all civilized nations, as well as the customs of barbarous races and tribes of men. That it is not proved by methods that afford demonstration matters not; mankind rests upon it to-day, always has so rested, and it is but logical to conclude, will make it the one fundamental idea of their moral government while humanity endures.

The question of life, however, is treated from a different standpoint, and, depending less upon mere dogma, its solution has been sought by scientific methods; facts have been found from which hypotheses have been born, and the rules of philosophic induction applied to discover the secret. Or, in other words, the origin of life has been sought by physical research and the physical basis of life has become a thing of the schools. This may be called the modern method, for it has only been possible since chemistry and the microscope have been the familiar agents of investigation. Much of the literature of science has been misdirected, in that in addition to its search for facts it has used those facts in a controversial sense, as against dogma—as if it made any difference to the fact what dogma taught. It does not change the fact of existence or destination one way or the other whether dogma be right or wrong—the result of the fact is purely intellectual freedom.

It matters not to knowledge whether dogma preaches a delusion, and it is a mistake in science, while denying to dogma the right to make a god, to copy its assumption by making him through a furnace or defining his attributes through optics. God-making is the by-path in all times that has led aside from the royal highway of knowledge, and the disciples of science can only follow it to the failure of their true mission.

In a former paper which I had the honor of reading before you, about life theories, after summing up all that had been then discovered, the result was given in these words: "There is no physical basis upon which a knowledge of how life came can rest. So far as those who assume to answer for science, there has been no answer." And the same must be said to-day. Since then much has been written, but no change in the verdict. The declaration of Tyndall still stands: that there is nothing living that did not derive its life from a pre-existing living thing. And M. Quatrefages, the most eminent of anthropologists, in a work since published, sums up the result of his life's labor, of his investigations and those of his co-laborers in this special field, in the all conclusive declaration: "I do not know."

Still the inquiry goes on, and the best minds in science, the most skilled in special investigation are as unceasing as ever, and the work of interrogating nature goes forward with zeal unabated and with vigor unrelaxed. The question of method is now the one that engages most attention, and what we may call the new hypothesis is that to which the highest skill and choicest learning are devoted.

In science, as in everything else, the phenomena of the human mind are manifest. We find those who are prone to rest on every new fact as final and covering the limit of what is knowable—counterparts of what we call the "conservative" in social Science. Newton never supposed that he knew everything, yet there are multitudes who think he did, and these are always pulling back on the wheels of progress and new discovery. And it is these men who cry out: "away with hypothesis, give us facts," while all that Newton ever discovered was the fruit of hypothesis. Science to-day is but a grain of fact in a measure of hypothesis, and our scientific literature is a volume of hypothesis from a chapter of facts. Hypotheses are to science what fertilizers are to the soil—the cause of the crop of fact.

One of the greatest obstacles to the presentation of philosophic truth is the necessity of using names, since the words employed to express abstract ideas of conditions by the mere force of repetition come to be associated in the mind as tangible things, and form a sort of intellectual furniture, only to hinder the clear conception and expression of things that have no tangibility, and, to be clearly understood, must be thought of aside from any material comparisons.

Thus, when we think of gravity, we call it a law, when it is only a conception of a state or relation between parts of a whole, that we call the universe. And there is connected with the word law a finite, a restricted idea, whi h, borrowing a coloring from our own methods, dwarfs the impression of its infinity, its eternity and its expression. We cannot dissociate the idea of its governing the movements of worlds, when it is only part of the universal whole which cannot be suspended, as there never has been a time or a conception of a time when it was not—because gravity is creation. We speak of matter under the same disabilities, and one of the most difficult things for the mind to do, and we might say impossible for it to do, is to think of matter without the association of something that is tangible to the material sense, something that has substance, form and dimension, whereas matter is only the name of the tool for handling an idea. We know matter is not the thing we associate it with in the mind, for there is no form of visible matter that, by methods known to us, cannot be made to disappear from all sense. We can attain to an intellectual recognition of matter in this conception, measurably, but as soon as we attempt to speak of it, the forms of speech dissipate the true conception again. This disabling obstacle interposes in all discussion from facts, and intrudes the physical basis of life as a theory, when in the nature of things, as we understand the word, there can be no such thing as the physical basis of life. To deal with the subject at all, we must do so by hypothesis, and the use of facts is to illustrate or to approve or disapprove the theory advanced. And why not?

Take for example the theory of evolution, to which the school that assumes to be pre-eminently scientific seems to hold as the ultimate of science in the direction of the origin of life. It is not fact, but only a hypothesis based on a hypothesis. The entire structure of materialism and its science, as related to the origin of life and the development of living things, rests on the nebular hypothesis. If that should be discovered not to be well founded, not only evolution, but many other far more generally received theories and systems would fall with it. Is it not then best to be respectful to hypothesis?

And just here allow me to digress and to make an observation pertinent to the argument to follow. It has always been a mystery how the advocate of the physical basis of life, or the materialist, can ignore the oneness of matter and the hypotheses that follow that idea, when the very foundation, the central fact upon which his entire theory rests, is that the solar system, the eternal basis of all things in his system, was at one time nothing—a mere expression—void. If it was so before the beginning, why not so now? Did the evolution into the nebulæ, and from the nebulæ into worlds necessarily change the original order of all matter in space? We know it has left an atmosphere as intangible, when at rest, as vacuity itself, and why not have left space still more ethereally occupied? In fact it has been negatively demonstrated that space is pervaded by a medium that transmits light, heat, and what we call the chemical rays of the sun. What are these chemical rays? Why not this very principle of life that we are in search of, and which, from a wrong conception as to matter, has lain, so to speak, under our very feet for all the ages? The universe is not a thing, a machine, made for us to look at and wonder how we would have gone to work to make it, but we are part of it, as actually as though we were a planet or a rock. We are but an expression of matter, as the rock or the tree; our bones and tissues are but expressions of matter, yet they have assumed form and substance, so far as our methods of inquiry go, from the same source that comes the faculty that describes them. But they are not necessary for life, as life exists without them, but they are necessary to the uses of the life that employs them. And here again we come to the inquiry which humanity has always been making.

And here, once for all, it may as well be said, that the "origin" of life is a misnomer, an assumption. The true philosophic inquiry is, how and when did life, as we know it or as we understand it, manifest itself upon our earth, and how? For the origin of life is with the infinite, and we cannot even form a conception of its beginning; it may never have had an origin. It may be the eternal principle itself, without beginning or ending, and knowable only by itself. It is egotism for humanity to assume itself the one perfect manifestation of life. We may be as low in the scale compared with other forms as are the merest rudimentary organisms of our own planet. Let not then this egotism overtask our powers of conception. It is enough, and to us godlike, to study its manifestations and to trace its processes as far only as the ultimate forms of matter and its phenomena may enable us to understand this principle, which to the universe of soul and sense is as that of gravity to the universe of material worlds.

We are now engaged in a new line of inquiry. When science began the study of the problem of life, it commenced at the foundation of things, the formation of the solar system, and thence to our house, the planet which we inhabit. The theory of the rocks grew from the nebular hypothesis, and the examination of the rocks supported the theory. The fossils in the rocks told the story of a once differing form of life to ours, of many epochs of differing forms, and so grew demonstration out of theory. That book of the rocks has been variously read, the last reading being by the light of comparative anatomy, until the hypothesis of spontaneous generation and evolution became the solution of science. But it has not so far, stood all tests. Thus we read up from the past, and we have the advantage of the wondrous store of knowledge obtained. If not conclusive, the mind of man is immensely the richer in its possessions for it.

The present method, however, is entirely different. It is from small things—going up from particles to aggregates and systems. We take now, instead of a stratum of rock, a molecule, and we learn its lesson. And this lesson is that all life is in its phenomena and appearance the same—whether of plant or animal. There is no difference in the appearance or action of the molecules of an oak and of a man. And so far as we can determine this little mass actually performs the work of growth as perfectly, and seemingly as intelligently, as does the bee its material work. So far as we can see it works consciously and with intelligent plan, purpose, and as we know, to uniform results. We call all this "force," but it is only a confusion induced by the necessity of words. In our mechanical contact with material objects, that we employ to control them we call force, and so in the barrenness of physical speech we apply the same term to this work of the creative energy, and this manifestation of an eternal and infinite purpose. But in the case of a tree we find the same as in that of the bones—the trunk, the wood, the bark and the leaves are forms of matter, but they are not necessary to the perpetuation of the life of the tree—that is in the seed. What is in the seed? That is just what we have never been able to discover. Here lies the mystery, and if we cannot grasp its presence, why try before we gain that secret, to question it as to its origin?

Now let us turn to a wider field. Many years ago the furnace and retort of the chemist found certain substances that were obdurate and refused to obey certain so-called laws that other substances did obey. These were called elements, and they were called so as forming the original substances of our world. Then came the discovery of the spectroscope, and it was found that some of these elements, many of them, existed in the sun. Then came the hypothesis, or scientific deduction, that the sun, earth and all the family of the solar system were of like composition—the same elements of matter. It is strange that with the nebular hypothesis as the basis of the solar system, this fact had not been accepted before. It is hard to conceive how it could be otherwise, if we place law over all. But is it not equally strange, that the other presumption was not considered? that as all were once mere nebulæ, that as the matter composing sun and worlds was in different states than in the beginning, that these differing states were only the different aspects of the same original nebulous mass; and it is still more strange, when we reflect that science held all the time to the theory of atoms and knew the law of atomic combination. The world had not then, nor has it now, got beyond the idea of matter, that it is something you can eat or kick.

But after the spectroscope came, the men with hypotheses began to investigate, and they found one line merging into another, one part, for example, of the sun's rays or atmosphere, or what they may be called, gave less lines or elements than another, until at one culminating point in the wondrous laboratory of our central orb, all disappear but the hydrogen line; or that all forms of matter, all elements, are but differing conditions of hydrogen. Still there are men, who having followed the study of matter from the supposed simples of the elements of our globe, up to this generalization of all substances into one, who yet deny the inevitable conclusion—the unity of matter. It is this class of conservatives who have placed, always, the barriers and finalities to knowledge, who seem afraid to face the tremendous fact that these discoveries suggest. And here they stop, and instead of a god of fossils and evolution, they make a hydrogen god, and shut the door in the face of the hypothesis, that there is still a God beyond the veil of hydrogen; that matter is still capable of a condition beyond that burning atmosphere which has absorbed all known forms of matter into its own.

But it may be asked in view of this criticism: Are we to give up scientific research in this direction ? By no means, for science is surely tracing out the path of inquiry that leads in the direction of the unknown. What is complained of, is that its disciples are too prone to stop at each step in advance, as if there was nothing beyond. Or it may be stated in another form : Science has so long combatted mere dogma, and soo utterly dethroned special providence, miracle and chance, that itself has become timid before the idea of the supernatural, and like the old creed builders who trembled at a fact, these scientists dread anything that suggests itself beyond the forces of the laboratory. They are almost as free to burn a heretic as were their persecutors in the past. If research leads to the border land between science, as we deal with it, and something beyond our methods, we must face it, and follow it as we may.

And now, leaving spectroscopic science on its hydrogen frontier, let us see what has been done in the laboratory. Here the progress has been greater than in the other field, but in the same direction. Of course reference is made to the experiments of Prof. Crookes, in what he calls, after Faraday, "radiant matter." And allow a digression here, for the benefit of those who have refused to accept what they may choose to call the unsupported testimony of Crookes, to say that within the month his experiments have been repeated and the truth of his theory demonstrated by our own great countryman, Henry Draper, before a large number of the members of the National Academy of Sciences.

This radiant, or as it is usually termed, the fourth state of matter, suggests another plea for hypothesis. What has now been demonstrated to the eye is but the proof by experiment of the hypothesis of Faraday, suggested sixty-five years ago, so that it cannot be said to be entirely new, but which men who did not want to think or who could not think, have ever since regarded as a vagary of that great mind. The formula for matter has been solid, liquid, gaseous, and to these Faraday had added radiant. Now science took no note, when it rejected this fourth condition, of the fact that it had stopped for a long period at the dual character of matter—solid and fluid—and that the gaseous was only a comparatively modern innovator. Still this did not prevent an incredulous, not to say a pitying, sympathetic smile, at this vagary of Faraday. Yet despite the still slow acceptance of it, it is a fact, proven to the eye before the British Association for the Advancement of Science, the French Academy and, as noticed above, before our own American Society.

It is not the purpose here to describe the phenomena attending the experiments that demonstrate the existence of this fourth state of matter ; only to note that in some of them the phenomena are in conflict with the accepted laws of matter heretofore recognized as immutable, and that it has different properties from any of the three. It evolves colors, and when intercepted by a solid body casts a shadow ; it is deflected from a straight line by a magnet, moves spirally, it exerts mechanical action where it strikes, and produces heat when its motion is arrested.

Now, these phenomena show, some of them, that what the experimenter was dealing with was matter, for it manifested the phenomena of matter under understood laws, while others show that it has phenomena peculiar to its condition, or which do not manifest themselves to our cognizance in any of the forms below it. Notably is this so as to colors. And by colors is not meant hues, merely, but colors that radiate and illuminate. This is something that no other form of matter known displays; and it casts a shadow. What a startling suggestion.

Now, crossing over from this disclosure of the vacuum tubes, let us take again the spectroscope, and we find that in one sphere of the emanations from the sun or its atmosphere, it bursts, so to speak, into a stupendous zone of color, and which in our barrenness of description is called the chromosphere. Is it then illogical to conclude that the radiant matter of the vacuum tube and the chromosphere of the sun are both but matter in the same state or condition? And thus do we, in strict accord with scientific methods demonstrate the truth of the hypothesis.

Now we get to a state of matter by two processes of analysis that present the same phenomenon—color—and we are for the first time, by physical methods, compelled to admit color into the family of entities, things, elements, or forces. Here then by regular methods of practical science, we are face to face with something heretofore unrecognized and uncatalogued, and we must take a new departure in investigation. We have reached a new continent and must push our explorations from a new base of observation, and with a new element of interpretation.

As yet we have discovered nothing that contradicts the atomic theory, and all these experiments as to radiant matter are based upon that theory and all results are in harmony with it. Then we conclude that in one state or relation or combination of atoms, the result is color, and that modifications of color are only variations, so to speak, of the normal relation or state of atomic combination that produces color; these colors of the vacuum tube, in one case, and the supreme glory of the chromosphere in the other. And now what?

As this refined condition of matter must be before colors become its expression, does not this refined matter interpenetrate everything and thus give to grosser matter, mineral, vegetable and animal, what we call their permanent tints, by which we read their nature as we read a book? And is not this refined matter but an expression of one of the phenomena of life, without which life cannot be? It must be so.

And now, with these two states of matter, or rather matter reduced by the two methods of investigation to a condition that discloses not only its homogeneous property, but its attenuation to a millionth part only of the density of air, what does it suggest? We refer next to the facts recited in the last paper already referred to, as disclosed by the microscope: that the molecules of living matter in the organisms of living beings, are simple, formless, colorless particles, that obey no known physical law, but as from some unknown source of power and store-house, build up the organism from a mere dimensionless point, endowed with a force and function that had no knowable origin or cause. Why not find it here in this condition of matter so ethereal in its refinement as to baffle the mind in its effort to realize it, but having a force to which nothing ponderable can be compared? Or, if even this, as we have tested it, is too crude to respond to the uses of the complex and wondrous thing we call life, why not follow it still farther to a yet more exalted state, through which the divine essence may quicken the forms of matter by which we recognize the phenomena of life? Is this hypothesis any more strained from the point of to-day than was that of Faraday from that of sixty-five years ago, with the testimony of both spectroscope and microscope added? Or must we, like the worshippers of the fossil god and the hydrogen god, set up this radiant molecular image and worship it, until some daring investigator with new appliances breaks the image and advances us another step in physical facts.

Our lame methods of illustration at best give but an unsatisfactory idea of the immense force and activity of this matter in the radiant state, but Flammarion's words may help in a degree to its realization. Speaking of Crookes' experiments before the French Academy, this eminent authority says: "The ball which Mr. Crookes uses, of four inches diameter, when exhausted to one-millionth of an atmosphere, still contains a quintillion of molecules, and its capacity a septillion. Now, pierce this globe with the aid of an electric spark, which traverses it through an opening entirely microscopic, nevertheless sufficient to permit air to enter it. If in this opening the molecules enter at the rate of a hundred millions per second, it would require more than four hundred millions of years to fill the ball, yet it is actually filled in an hour through the microscopic opening." The mind cannot grasp such numbers, nor is it flexible enough to sense such infinitely small particles. But it enables it in some degree to imagine the force, activity and power of matter in its ultimate forms, and to satisfy the mind that life, through the still larger comparative masses of protoplasm, as quickened by this inconceivable energy, is possible.

Here, then, we find the basis for a new hypothesis as to life, not as to the origin of life; for that lies still behind, but as to the union between life and organic development, for here all seeming necessary conditions meet, and we can conceive how such tremendous and exalted forces, operating through this plastic material, may create the environment for the production of living phenomena. It seems indeed as if here must end the inquiry into the phenomena of life in this direction, as it is difficult to imagine how a farther refinement of matter by physical methods is possible, or how it could aid what appears so clear—that life as we see it must thus find its expression through organic forms. We have followed it with sure footsteps to this border land, and we know it cannot come in any other way. So far the hard demand for facts has been met. This much seems to have been necessary for physical science to do, for without it superstition, dogma, or credulity had no limit; the infinite was simply chaos, stirred by any vagrant force that, surrounded by its own agitation, called itself the all. But this has given a basis on which the mind can rest and from which reason can reach out toward the final cause; it has led us to the shores of the mysterious ocean, upon which the explorer may launch his barque, with the compass of ultimate facts to direct his voyage in search of the still unknown. If life is from the gestation of nature, here is the point from which to question her. If being, consciousness, and the immortal longing of humanity is from the ever living source of the great first cause, here is where the quickening power is first manifest, and from which we must reach out and find food to satisfy that infinite hunger which has ever been the burden of the soul. It cannot be found by following in by-paths, only by traveling the road as it lengthens beyond.

The inquiry is very old: "Who by searching can find out God?" And it is as apt to-day as then. Searching by analysis can never discover Him, nor can it satisfy the reason or the imagination. It can dispel illusion, expose fallacy, confound dogma and instruct faith, because it can show what is not and what cannot be. But analysis is always negative; it does not create, only explains what is created. The higher knowledge comes from the synthetic; it takes up these parts from the hand of analysis and with them builds the tower of wisdom, whose summit basks in the sunlight of infinite truth. And by this method, "the immortal white flower of all reason," we may cross this border land and explore that which is still hidden.

In all that has been seen, there is not a suggestion of evidence that matter itself is life—it is only the medium of a force that as yet has evaded all challenge by our methods, of its presence. But what is it that like an open book lies before us, from the rudimentary rock to the inconceivable forces of matter in these ultimate forms? It is that there is a dual principle, an active and a passive; that the one controls, molds, quickens, and the other responds, adapts, lives. This fact is ever present, as constant as law—it is the law.

If, then, there is, as all fact demonstrates, this dual force, there is one more refined which constitutes life, and must have a kindred force or energy by which it can manifest itself in the world of organized forms. And here is where it meets matter in the dual office; here is where, in other words, life marries matter for the uses of the infinite in the worlds of created substance throughout the universe. It cannot be otherwise. We must here find the heart of the great mystery.

And, now, by the light of these new facts, and the suggested hypothesis, how beautiful do the processes of nature become, joined as it is by its own ultimate states to the sources and quickening forces of the infinite. Matter assumes a new beauty, the beauty of use. The æsthetic sense is no longer repelled by the crude suggestion that the flower, a rose and its perfume, is only matter, for it can understand the wondrous work of these invisible forces that from the intangible air distils such marvelous odors and from the rains and dews evolves the wondrou- fabric of the rose leaf and its color. It feels that matter as we see it, as we feel it, is only the garniture of the soul within, that loves it for what it expresses. It feels that it is but the very dross of materialism, born of this material sense, to make the faculty of mind, consciousness, imagination and soul but the accident, the factory work of mere physical phenomena, which is by courtesy called law. And science, though it may never solve the mystery of life, has by these later discoveries, forever overthrown the hideous nightmare which in its name has been brooding over the human soul and crushing out its aspirations, toward the immortal and unknown, by the benumbing weight of materialistic annihilation; that the soul of man was but a phantom of chemistry that expired with the fires of its containing crucible. Because, what from its minutest form and phenomena to its aggregation in worlds and systems of worlds is all under law and controlled by cause, cannot itself be without cause. This must be, or mind is causeless and without existence. How that cause works to produce life is what we are in search of, and the hypothesis that is sustained by the facts must be the true one.

We must, then, in the light of these discoveries, revise the methods of discussion, dismissing the old questions and formulæ, for they constitute a point of departure back of which the dogmas of the schools are useles. The materialist must revise his theories, for he can no longer borrow from the geologist, nor fortify himself from the earlier teachings of the astronomer. The sun is no longer a mere furnace, stoked by meteors and cometic fuel; this old earth of ours is no more a mass of cooled slag, nor is space a void where eternal cold is only disturbed by the swift rush of planets as they swing their eternal round, the first worshipers of the inevitable fire that will go out when all are consumed. The evolutionist, too, must seek elsewhere than in the festering ferments of primeval slime for that divine spark, which first chambered in a sponge now questions the mysteries of the first cause from this borderland between the living and the life; that has laid its hand upon the forces that grasp the solar system and keeps the stars and worlds in their places; that finds in space the same materials that compose the rocks, the water, the air, and that makes planet responsive to planet, each giving and receiving that which in common phenomena proclaims them all akin. He must find, not a life animal and vegetable alone, existing where all else is dead, but a universe instinct with a life far beyond that of any of its parts, of which our life on this little globe is but a result, a mere expression of the all pervading source of life from which the worlds were born, and in which the universe exists.

Prof. E. S. Holden, of the Naval Observatory at Washington, has accepted the managership of Washburn Observatory at Madison, Wisconsin, made vacant by the death of Prof. Watson, and will enter upon his duties within a few weeks.

GEOLOGY AND PALÆONTOLOGY.

THE ANTIQUITY OF MAN AND THE ORIGIN OF SPECIES.

PRINCIPAL J. W. DAWSON, MONTREAL, P. Q.

(*Concluded.*)

To return to primitive man and the date of his appearance in Europe, an important question is raised by Dawkins in the attempt which he makes to discriminate between two races of men supposed to have existed successively in Europe in postglacial times or in the Second Continental period. These he calls respectively "men of the river gravels" and "cave men." The idea of such distinction seems to have arisen in his mind from the fact that in certain caverns in England the lowest stratum containing human remains affords only rude implements, while an upper stratum appears to testify to improved manufacture of stone tools and weapons; both strata being of so-called "paleolithic" age—that is, belonging to the time when certain mammalia now extinct survived. Such facts, however, would rather seem to testify to local improvement in the condition of certain tribes than to any change of race. Such local improvement would be very likely to occur wherever a new locality was taken possession of by a small and wandering tribe, which in process of time might increase in numbers and in wealth, as well as in means of intercourse with other tribes. A similar succession would occur when caves used at first as temporary places of rendezvous by savage tribes became afterward places of residence, or were acquired by conquest on the part of tribes a little more advanced, in the manner in which such changes are constantly taking place in rude communities. Yet on this slender foundation he builds an extensive generalization as to a race of river-drift men, in a low and savage condition, replaced after the lapse of ages by a people somewhat more advanced in the arts and specially addicted to a cavern life; and this conclusion he extends to Europe and Asia, finding everywhere and in every case where rude flint implements exist in river gravels, evidence of the earlier of these races. But his own statements are sufficient to show the baselessness of the distinction. He admits that no physical break separates the two periods, that the fauna remained the same; that the skulls, so far as known, present no differences; and that even in works of art the distinction is invalidated by grave exceptions, which are intensified by the fact, which the writer has elsewhere illustrated, that in the case of the same people, their residences in caves, etc., and their places of burial are likely to contain very different objects from those which they leave in river gravels. Perhaps one of the most curious examples of this, referred to by our author, is the cave of Duruthy in the western Pyrenees. On the floor of this cave lay a human skull covered with fallen blocks of stone. With it were found forty canine teeth of the bear and three of the lion, perforated for suspension, and several of these teeth are skillfully engraved with figures of animals, one bearing the engraved figure of an embroidered glove. This necklace, no doubt just such a trophy of the chase as would now be worn by a red Indian hunter, though more elaborate, must have belonged to the owner of the skull, who would appear to have perished by a fall of rock, or to have had his body covered after death with stones. In the deposit near and under these remains were flint flakes. Above the skull were several feet of refuse, stones, and bones of the horse, reindeer, etc., and "paleolithic" flint implements, and above all were placed several skulls and skeletons with "beautifully chipped" flint implements. After the burial of these the cave seems to have been finally closed with large stones. The French explorers of this cave refer the lower and upper skulls to the same race; but Dawkins, in consistency with his theory, has to consider the upper remains as "Neolithic," though there is no conceivable reason why a man who possessed a necklace of beautifully carved teeth should not have belonged to a tribe which used well-made stone implements, or why the weapons buried with the dead should have been no better than the chips and flakes left by the same people in their rubbish-heaps.

The reasoning by which the author supports this distinction is throughout scarcely worthy of his reputation, and implies great carelessness as to modern analogies. The same remark may be made as to his identification of the cave men with the Esquimaux. What he says on this head would serve quite as well to identify them with other hunting and fishing people; with the Haidas of the Queen Charlotte Islands, for example, the Micmacs of Nova Scotia, or even the Fuegians. He exposes, however, the folly of the minute distinctions made by some French archæologists as to the ages of the remains in different caves, and which, as Lyell and others have insisted, prove no more than slight differences of wealth and culture among contemporary or immediately successive tribes.

Another point on which he well insists, and which he has admirably illustrated, is the marked distinction between the old paleocosmic men of the gravels and caves and the smaller race with somewhat differently formed skulls which succeeded them, after the great subsidence which terminated the Second Continental period and inaugurated the Modern epoch. The latter race he identifies with the Basques and ancient Iberians, a non-Aryan or Turanian people who once possessed nearly the whole of Europe, and included the rude Ugrians and Laps of the north, the civilized Etruscans of the south, and the Iberians of the west, with allied tribes occupying the British Islands. This race, scattered and overthrown before the dawn of authentic history in Europe by the Celts and other intrusive peoples, was unquestionably that which succeeded the now extinct paleocosmic race and constituted the men of the so-called "Neolithic period," which thus connects itself with the modern history of Europe, from which it is not separated by any physical catastrophe like that which divides the older men of the mammoth age and the widely spread continents of the post-glacial period from our modern days. This identification of the Neolithic men with the Iberians, which the writer has also insisted on, Dawkins deserves credit for fully elucidating, and he might have carried it farther to the identification of these same Iberians with the Berbers, the Guanches of the Canary Islands, and the Caribbean and other tribes of eastern and central America. On these hitherto dark subjects, light is now rapidly breaking, and we may hope that much of the present obscurity will soon be cleared away.

Another curious point illustrated by Dawkins, with the aid of the recent re-discovery of the tin-mines of Tuscany, is the connection of the Etruscans with the introduction of the bronze age into central Europe. This, when viewed in relation to the probable ethnic affinities of the Etruscans with the "Neolithic" and Iberian races, remarkably welds together the stone and bronze ages in Europe, and explains their intermixture and "overlap" in the earlier lake habitations of Swizerland and elsewhere.

We are also indebted to our author for a suggestion as to the linguistic connection of the Neocosmic and Modern periods, which is deserving the attention of philologists. He quotes from Abbè Inchaurpè, the following Basque words:

Aizcora	= Axe	= Stone lifted up or handled.
Aitzurra	= Pick	= Stone to tear asunder.
Aizttoa	= Knife	= Stone, little or small.
Aizturrac	= Scissors	= Little stones for tearing.

He remarks that all these words are derived from the word *aitza*, *atcha*, stone, though now applied to implements of metal. The same thing occurs in many American languages, in which the word for stone, with appropriate additions, is applied to different kinds of tools. It is also curious that in some of the American languages the word for stone is almost identical with that in Basque; but this applies to some other Basque roots as well. Still it is not unlikely that the onomatopoietic sounds, *itz*, *aitz* and the like, applied to stones and cutting instruments in many languages, in all cases arose from the use of sharpened stones in cutting and rending.

A still more important speculation arising from the facts recently developed as to prehistoric men is the possible equivalency with the historical deluge of the great subsidence which closed the residence of paleocosmic men in Europe, as well as that of several of the large mammalia. Lenormant and others have shown that the wide and ancient acceptance of the tradition of the deluge among all the great branches of the human family necessitates the belief that, independently of the biblical history, this great event must be accepted as an historical fact which very deeply impressed itself upon the minds of all the early nations. Now, if the deluge is to be accepted as historical, and if a similar break interrupts the geological history of man, separating extinct races from those which still survive, why may we not correlate the two. The misuse of the deluge in the early history of geology, in employing it to account for changes that took place long before the advent of man, certainly should not cause us to neglect its legitimate uses, when these arise in the progress of investigation. It is evident that if this correlation be accepted as probable, it must modify many views now held as to the antiquity of man. In that case, the modern gravels spread over plateaus and in river valleys, far above the reach of the present floods, may be accounted for, not by the ordinary action of the existing streams, but by the abnormal action of currents of water diluvial in their character. Further, since the historical deluge cannot have been of very long duration, the physical changes separating the deposits containing the remains of paleocosmic men from those of later date would in like manner be accounted for, not by slow processes of subsidence, elevation, and erosion, but by causes of more abrupt and cataclysmic character. This subject the writer has referred to in previous publications,* and he is glad to see that prominence has recently been given to it by so good a geologist as the Duke of Argyll, in a late number of the *Contemporary Review*.

It is a great leap backward to pass from the bronze age of Europe to the Paleozoic brachiopods of Bohemia; but both may furnish illustrations of the same natural laws, as both belong to the same long-continued creative work. Barrande, like some other eminent paleontologists, has the misfortune to be an unbeliever in the modern gospel of evolution, but he has certainly labored to overcome his doubts with greater assiduity than even many of the apostles of the new doctrine; and if he is not convinced, the stubbornness of the facts he has had to deal with must bear the blame. In connection with his great and classical work on the Silurian fossils of Bohemia, it has been necessary for him to study the similar remains of every other country, and he has used this immense mass of material in preparing statistics of the population of the Paleozoic world more perfect than any other naturalist has been able to produce. In previous publications he has applied these statistical results to the elucidation of the history of the oldest group of crustaceans, the trilobites, and the highest group of the mollusks, the cephalopods In his latest memoir of this kind he takes up the brachiopods, or lamp-shells, a group of bivalve shellfishes, very ancient and very abundantly represented in all the older formations of every part of the world, and which thus affords the most ample material for tracing its evolution, with the least possible difficulty in the nature of "imperfection of the record."

Barrande, in the publication before us, discusses the brachiopods with reference, first, to the variations observed within the limits of the species, eliminating in this way mere synonyms and varieties mistaken for species. He also arrives at various important conclusions with reference to the origin of species and varietal forms, which apply to the cephalopods and trilobites as well as to the brachiopods, and some of which, as the writer has elsewhere shown, apply very generally to fossil animals and plants. One of these is that different contemporaneous species, living under the same conditions, exhibit very different degrees of vitality and variability. Another is the sudden appearance at certain horizons of a great number of species, each manifesting its complete specific characters. With very rare exceptions, also, varietal forms are contemporaneous with the normal form of their specific type, and occur in the same localities. Only in a very few cases

* "Origin of the World," Fossil Men."

do they survive it. This and the previous results, as well as the fact that parallel changes go on in groups having no direct reaction on each other, prove that variation is not a progressive influence, and that specific distinctions are not dependent on it, but on the "sovereign action of one and the same creative cause," as Barrande expresses it. These conclusions, it may be observed, are not arrived at by that slap-dash method of mere assertion so often followed on the other side of these questions, but by the most severe and painstaking induction, and with careful elaboration of a few apparent exceptions and doubtful cases.

His second heading relates to the distribution in time of the genera and species of brachiopods. This he illustrates with a series of elaborate tables, accompanied by explanation. He then proceeds to consider the animal population of each formation, in so far as brachiopods, cephalopods and trilobites are concerned, with reference to the following questions: (1) How many species are continued from the previous formation unchanged? (2) How many may be regarded as modifications of previous species? (3) How many are migrants from other regions where they have been known to exist previously? (4) How many are absolutely new species? These questions are applied to each of fourteen successive formations included in the Silurian of Bohemia. The total number of species of brachiopods in these formations is 640, giving an average of 45.71 to each, and the results of accurate study of each species in its characters, its varieties, its geographical and geological range, are expressed in the following short statement, which should somewhat astonish those gentlemen who are so fond of asserting that derivation is "demonstrated" by geological facts:

1. Species continued unchanged	28	per cent.
2. Species migrated from abroad	7	"
3. Species continued with modification .	0	"
4. New species without known ancestors.	65	"
	100	per cent.

He shows that the same or very similar proportions hold with respect to the cephalopods and trilobites, and in fact that the proportion of species in the successive Silurian faunæ, which can be attributed to descent with modification, is absolutely *nil.* He may well remark that in the face of such facts the origin of species is not explained by what he terms "les èlans poètiques de l'imagination."

The third part of Barrande's memoir, relating to the comparison of the Silurian brachiopods of Bohemia with those of other countries, though of great scientific interest and important in extending the conclusions of his previous chapters, does not concern so nearly our present subject.

I have thought it well to direct attention to these memoirs of Barrande, because they form a specimen of conscientious work, with the view of ascertaining if there is any basis in nature for the doctrine of spontaneous evolution of species, and, I am sorry to say, form a striking contrast to the mixture of fact and fancy on this subject which too often passes current for science in England, America, and Germany. Barrande's studies are also well deserving the attention of our younger men of science, as they have before them, more especially in the widely spread Paleozoic formations of America, an admirable field for similar work. In an appendix to his first chapter, Barrande mentions that the three men who in their respective countries are the highest authorities on Paleozoic brachiopods, Hall, Davidson, and De Koninck, agree with him in the main in his conclusions, and he refers to an able memoir by D'Archiac in the same sense, on the cretaceous brachiopods.

It should be especially satisfactory to those naturalists who, like the writer, have failed to see in the paleontological record any good evidence for the production of species by those simple and ready methods in vogue with most evolutionists, to note the extension of actual facts with respect to the geological dates and precise conditions of the introduction of new forms, and to find that these are more and more tending to prove the existence of highly complex creative laws in connection with the great plan of the Creator as carried out in geological time. These new facts should also warn the ordinary reader of the danger of receiving without due caution those general and often boastful assertions respecting these great and intricate questions, made by persons not acquainted with their actual difficulty, or by enthusiastic speculators disposed to overlook everything not in accordance with their preconceived ideas.—*Princeton Review.*

THE PLIOCENE BEDS OF SOUTHERN OREGON.

BY CHAS. H. STERNBERG.

In the year 1877, while at work in the fossil fields of Western Kansas, I received orders from Prof. Cope, in whose employ I was, to go at once to a new locality, discovered in the Desert of Southern Oregon and said to be very rich in fossil remains. A few days were sufficient to make all needful preparation, and I was on my way by rail through the grand and impressive scenery of Weber and Echo Cañons of the Rocky Mountains. Among the towering peaks of the Sierras, by stage, past Castle Rock and old Mount Shasta, in California, and on to Fort Klamath, Oregon, where I procured pack animals and hired an assistant. After various adventures I reached Silver Lake, near which I expected to find the bone yard, as the people called it. A guide led us through an alkaline desert covered with sage brush and greasewood. A journey of twenty-eight miles brought us to a small alkaline lake, on the margin of which lay the remains of extinct animals, on a bed of clay, all exposed. The volcanic ashes and sand that had covered them had been blown away. As night was fast approaching when we reached the fossil field, we gathered a huge pile of sage brush, pitched our tent, and soon had a comfortable fire, and after a hearty meal, we stretched ourselves on our blankets and listened with lighted pipes to the stories of our guide; and hough we were twenty-eight miles from human habitations, and in spite of the howling of the wolves, we made ourselves comfortable. In the morning we were early astir, and during the day made the largest collection of fossil bones I ever got in the same length of time. They were in a fine state of preservation. One unfortunate thing was the absence of perfect skeletons. The skulls had been broken to pieces, doubtless beneath the feet of herds of antelope and deer, that came daily to the lake for water. Teeth, limb bones and vertebræ were common. We found great quantities of fish bones, which were usually detached and represented animals from the size of a trout to a large salmon. About two thirds were of existing species. Birds, also, were abundant, in size from a sandpiper to a stork. They were all of existing species. Great piles of *Planorbis* and other species of fresh water shells looked like snow drifts. Among mammals the horse and llama were most common, three species of each. *Equus major* was as large as our American stock, though with rounder limb bones. *E. occidentalis* was about the size of a small Indian pony. Of the Llama the species were *ancherria hesternia*, *A. major* and *A. vitakeriana*. Specimens were found of a great sloth, *Mylodon*. *Elephas primigenius* left its bones in profusion. They were usually broken, especially the tusks. A few days exploration convinced me that great numbers of animals had been destroyed at once, and an examination of the volcanic sand and ashes that had covered them proved that they had sought shelter from a fierce storm of sand and ashes, from an active volcano in the vicinity, and beasts of all descriptions forgot their natural instincts, and rushed together to the cooling waters of the lake. The gigantic elephant, the horse, llama, deer, wolf and other smaller animals awaited with fear the storm that must overtake and bury them beneath the accumulating *debris*.

One reason for this opinion is the great profusion of remains around the lake. Another is that only isolated bones are found at a distance, showing where some animals had been overtaken by the storm before it reached the lake. What a commotion there must have been on that fearful day, when all the beasts of Southern Oregon found death and burial. Great piles of sand and ashes are found near the lake, carried there by the wind, into which ones horse sinks a foot or more. Among these heaps of sand I found an old Indian village, with old mortars and pestles lying around. Also numerous arrow and spear heads of obsidian. Here and there were heaps of obsidian chips, showing where the old arrow makers had had their shops. Who knows but what man was a witness of the scenes we have described, and perished amidst the storm of burning ashes.

THE QUATERNARY OF WASHINGTON TERRITORY.

BY CHAS. H. STERNBERG.

Prof. Broadhead's interesting article on the Mastodon puts me in mind of some explorations I made in the Winter of 1877–78. While traveling on the Columbia river I met an army surgeon, who told me of mastodon bones being found on Pine creek, Washington Territory. I resolved to go there at once, and went to

Walla Walla to outfit, and with two assistants, went to Pine creek, where I met Mr. Copeland who had made large collections of remains of the Hairy Mammoth. He had felt a large skull in a spring on his farm, and with grappling irons hauled it to the surface. It proved a perfect specimen and excited his desire to obtain more. He therefore hired a number of men and proceeded to drain and dig out the spring. He first went through a bed of peat, then of clay and found a great many bones in a bed of gravel below, about twelve feet from the surface. He obtained a large collection of mammoth bones, as well as those of the bison and smaller animals. Mingled with the bones were pieces of charred wood. I discovered a spring near the head of Pine creek that promised well, as I could feel bones with a long pole. It was 100 yards from the creek and on about the same level. I first dug a ditch from the spring to the creek, which lowered the water about three feet. Then we dug down on the margin of the spring, through a bed of peat five feet in thickness, and through five feet of clay, hauling up the soft mud and water with buckets. Every night the hole we made during the day was filled with water and it had to be bailed out in the morning. At last we found the bed of gravel, with numerous bones lying on and through it. But, unfortunately, they did not belong to the mammoth, but to the North American bison, deer and other small animals of existing species. One interesting fact was, we found flint arrow heads and an instrument of bone mingled with the bones. This fact taken alone would only prove that man existed with the common bison. But taken in connection with Mr. Copeland's discoveries, it would prove that both man and the bison were contemporary with the mammoth, as man's implements associated with remains of the bison, were found under the same circumstances and vicinity with Mr. Copeland's specimens. Another proof of the great age of the bison is from the fact that its remains are found in various parts of Washington Territory and Oregon in beds of gravel, under twelve feet of lava. Hence, I suppose that if man, the mammoth and bison were contemporary, they were doubtless destroyed by an outflow of lava that covered most of eastern Washington Territory and Oregon.

ARCHÆOLOGY AND ANTHROPOLOGY.

ORIENTAL RESEMBLANCES IN NEW MEXICO.

BY C. N. HOLFORD.

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But there is to be seen here in New Mexico the impress of a civilization (the Arabic) older than that of Europe, older than that of Ancient Rome. And there are some grounds for believing that the ancient Pueblo civilization which the Spanish conquerors found here, and to a great extent displaced, is, if not the direct offspring, at least the kindred of the civilization of the Egypt of four thousand years ago. The character of many of the ancient ruins from Zuni to Palenque and Copan, the type of heads and features sculptured thereon, the pottery of the Pueblos and Navajos—all, if not exactly resembling those of ancient Egypt, resemble nothing else in the world so much. The wooden plow used by the Indians of this Territory to-day is of the exact type found sculptured upon monuments that were old before the walls of Troy were built. The character of the country and climate considerably heightens these resemblances. Standing near one of these Indian pueblos and reading a page of Bayard Taylor's journey up the Nile, you might easily fancy as you looked around that the great traveler was describing the scene before you. The rude houses of sun-baked mud with occasional bits of vineyard about them; in the back-ground the barren flats or the low yellow sandhills; in front the broad river, its turbid waters changed to gleaming silver by the slanting rays of the blazing sun; and over all the pale, hot, quiet, cloudless sky. The dusky inhabitants in their scanty white cotton garments moving languidly about, the asses plodding afield or standing with mournfully drooping heads, and the rude, antique-looking implements seen here and there, harmonize well with the rest of this picture of ancient Egypt, as it were.

I have said that Spanish New Mexico bears tokens of the influence of the Arabian civilization, and it may not be clear at first sight how it can be so. It will be remembered that the immediate successors of the great Arab prophet carried their conquering arms and fanatic faith, not only to the walls of Vienna on the north, but along the whole southern coast of the Mediterranean, then swarmed up into Spain, crossed the Pyrenees and overran half of France. Though the mace of Charles Martel crushed their front at Poitiers and the swords of the Paladins scourged them back across the mountains, they held possession of more or less of Spain for nearly eight hundred years. Not only did this long dominion of so energetic a race deeply impress Spanish customs and architecture, and mingle, no doubt, much of its blood with the Spanish race, but when the last king of the Spanish Moors yielded the keys of his capital to the consort sovereigns of Aragon and Castile and bade adieu forever to the Alhambra's marble halls, many thousands of the Moors remained behind to still further impress their characteristics upon Spain. When they were finally expelled eighty years later by the foolish bigotry of Philip II Spain lost in them her most substantial citizens-her most skillful mechanics and enterprising traders. But, even thus, it is estimated that there are 60,000 *Morescos*, or persons of Moorish descent, in Spain. It is highly probable that so fine an opportunity for adventure as was opened by the discovery of the New World was embraced by thousands of an adventurous race whose ancestors carried their banners over two thousand leagues of conquest in Europe and Africa, and it is not unlikely that many of these *Morescos* were in the vanguard of the *Conquistadores*.

Santa Fe, except in its new American features, is a type of the remote, half-

Moorish towns of Estramadura three hundred years ago. The influence of the rest of Europe has greatly changed Spain since the days of Charles V, but that influence fell far short of New Mexico. In a few nooks of Spain a hundred years ago were remnants of these things which had already vanished from the more accessible localities. Cadalso, in his *Cartas Marruecas*, writing from one of these nooks, says: "The somber costumes, the women secluded in the houses or appearing on the streets only with faces muffled in black shawls, the houses with their blank street walls jealously hiding the inner courts * * * * * and many other things, have made me look into the almanac to see if it was really the year 1765, or the year 1500." Many of these things, to be seen only in the nooks of Spain a hundred years ago, can be seen in some New Mexican towns in the year 1880.

The ancient architecture of New Mexico is decidedly Moorish—though in the matter of public buildings, in the palmy days of the Moors in Spain, the Moors built of marble where the Mexicans have built of mud, yet in their less pretentious buildings adobe formed the principal materiel of both people.

Lately I met a Frenchman who had spent twelve years in northern Africa and Arabia, and he said that for appearance of country, buildings, people, animals, climate, etc., the Rio Grande valley might seem to be a slice taken out of Algiers or Arabia—at least if the Gringo were taken out and the camel put in.

Had I space and access to books, to illustrate the resemblance of this country to orient lands I might quote from the writings of many observers, from the wonderful narrative of Moses, read by more than a hundred generations, to the pages of Bayard Taylor which, fresh from the writer's hand, charmed me when a boy. The soil, the sky, the animals, the implements, the pursuits and the manufactures—what a wonderful resemblance in those of the two regions. The rude Mexican cart with its ponderous wooden wheels and wicker boxes of cane or willow rods, drawn by oxen whose yoke is a straight stick lashed to their horns with rawhide thongs—just such carts are pictured in the most ancient bas-reliefs of the Orient—just such carts bore Jacob and his very numerous family from famine-stricken Canaan to meet his long-lost son, the viceroy of Egypt—just such carts bore the plunder of the Israelites on their long journey from the pastures of Goshen to the fords of Jordan—just such carts bore the baggage of Mohammed's lieutenants, toiling and creaking through three thousand miles of desert sands, from the Red Sea coast of Arabia to the Atlantic coast of Morocco.

The manner of threshing, cleaning and grinding grain, (and, it may be said, of growing and gathering it) in this region is the same as is described in the earliest records of the oriental nations. Moses wrote concerning "the ox that treadeth out the corn," and the ox is yet used, along with the ass and the goat, for treading out the grain of New Mexico. The Mexican threshing-floor is of the same description as that which David bought of Araunah the Jebusite, and the Mexican now winnows out his wheat in exactly the same manner as Boaz the Moabite was winnowing out barley the breezy evening that Ruth came a courting him. "Two women shall be grinding at the mill," says the Hebrew prophecy, and it is said that in some parts of this territory to-day two women together grind wheat betwen flat stones—the one partly grinding it and the other completing the operation.

The "bottles" for wine mentioned in ancient records are known to have been goat-skin flasks, and such are in use to-day in this country; and so are the rawhide wine vats, such as were used by the wine makers of Syria ages ago, and perhaps even by the sons of Noah. Our native adobe-makers would probably find making "bricks without straw" as unsatisfactory as did the Hebrew slaves of the Egyptians thirty-four hundred years ago.

The ass and the goat, the "flocks and herds" of sheep, and the "cattle upon a thousand hills," are features upon almost every page of the literature of "the children of Shem dwelling in tents," from the day of Abraham to this day, as they would be in a literature descriptive of every-day life in the Mexican "plaza" or on the lonely ranch. In fact, the American tourist who is unable to visit Syria, Arabia, Egypt and Barbary, but who wishes to realize in the sight of living forms and actual landscapes what he has read of these "cradle lands," should come to New Mexico before the Gringo with his steam and electricity shall have swept away all these oriental resemblances except the landscape and the climate.—*Thirty-Four.*

ANCIENT WORKS IN NEW MEXICO.

New Mexico is perhaps the most noted country in the world for research. The historian, the wealth seeker and the "curious" can here find a rich field and reward for their labor. The Abo and Gran Quivira counties are perhaps the most renowned in the Territory for research. In the former there are evidences of great volcanic eruptions which overwhelmed cities and buried the inhabitants in ashes and lava long ages ago. It is evident that these people, who are perhaps older than the Aztecs, were a prosperous race, with not a little advance in civilization, as the Abo ruins in the Manzana Mountains indicate; also some indications of fine art; rude figures and the images of animals being found upon the interior of the walls of the structures beneath the debris.

It is evident that this non-historic race were seekers after mineral, and evidences also exist that mineral was obtained by them in paying quantities, there being the ruins of many old smelters and acres of slag found near Abo. Here mines are found with the timbers so rotten with age that great difficulty is experienced and danger incurred in going down into the old shafts, where shafts are formed.

One of our informants gave as his belief that either the flow of lava or falling leaves and dust had filled many of the shafts up, and the sand, earth and leaves so completely covered the ground that great care is required to find them, with but one or two exceptions—the Mount of the Holy Cross (so named) being about the only one that could be easily discovered.

One especially was found where human hands or lava or falling leaves and dust had filled it level with the earth, no shaft being discernible, and would not have been found, perhaps, had not an old trail been discovered. This was dug into and at a depth of twelve feet a man could, in places, thrust his arm in up to the elbow between the granite walls of the mine and the earth which filled the old shaft. The mineral, unlike our White Oaks country, does not seem to outcrop, but seems to be deep in the earth; no float having been found as yet except near the shafts or around the old smelters. On the eastern slope of the Manzana Mountains no quartz has been found excepting in a very burned and blackened condition. This part of the country will perhaps yield immense mineral wealth in time, and further developments and prospecting is awaited with great interest to many.

The walls of some of the old ruins at Abo are six feet of solid stone—lime and red sand—the walls in places are yet six feet in height and in a state of perfect preservation. In the ruins are found vessels of various designs and sizes made of pottery—some representing birds and animals. Stone hammers are found here, but no indications that sharp-edged tools were used in this ancient period. In digging down in one place the remains of an old aqueduct was found, which was probably used, as in the present day by the Mexicans for supplying the inhabitants with water.

It is thought and believed, by specimens of ore found, that gold, silver and copper were found in paying quantities. All the rock is more or less copper stained and some of it is so much so that some of the "country" rock has run as high as 37 per cent. copper.

Surely our bright, sunny land has been enjoyed long before the Anglo Saxon made his appearance upon the scene. The future of New Mexico can only be surmised. Every day new evidences of untold wealth are thrust upon us, and the day is not far distant when the multitudes of the East will flock to our borders and assist in the development of the greatest mineral region in the world.—*Era.*

CHEMISTRY.

CHEMISTRY IN 1727.

PROFESSOR T. BERRY SMITH, LOUISIANA COLLEGE, MO.

I have been reading a book—very large book—whose title page reads thus: "A New Method of Chemistry, written by the very learned H. Boerhaave, Professor of Chemistry, Botany and Medicine in the University of Leyden, etc., etc., translated by P. Shaw, M.D., and E. Chambers, Gent, London, MDXXVII CCXXVII."

I have found such curious ideas, statements, hypotheses, reasonings and conclusions in it, that I have deemed it would be interesting to the readers of the Review to write down a few of them and have them again set in type. Of course, they will not now be printed with "f" for "s" and "em" for "them" and such other ancient modes for putting things; but, nevertheless, the words corrected and ideas will be interesting. I cull out only a few of the most strange statements, though the whole book is a curiosity.

I quote first the definition of Chemistry: "Chemistry is an art, whereby sensible bodies contained in vessels (or at least *capable* of being *contained* therein and *rendered* sensible;) are so changed by means of certain instruments, and especially fire, that their several powers and virtues are thereby discovered; with a view to the uses of Medicine, Natural Philosophy and other arts and occasions of life."

The author then proceeds to explain the various parts of the definition somewhat as follows:

It deals with *sensible* bodies. Bodies are sensible when they affect our senses; insensible when so *small* or so *remote* that they work no notable change on our organs of sense. Thus the air is full of an infinite number of heterogeneous corpuscles which have indeed an effect on our bodies, but it is such as our senses take no cognizance of.

They must be sensible bodies capable of being contained in vessels. The moon, though a sensible body, is no object of chemistry, for it is not capable of being contained in vessels. Gases are insensible aura or exhalations that would fly away unperceived; but being caught in alembics and retorts, come under the notice of our senses.

The "very learned" author then goes on to divide the world into three kingdoms much the same as we do at the present time; save that he uses the word "fossil" as we do "mineral." His definitions are these: *Fossils* grow adhering to the earth, and without distinction of parts. *Vegetables* grow adhering to the earth, and with distinction of parts. *Animals* grow without adhering to the earth at all.

He is very profuse in explanation. Passing on, we come to his divisions of the fossil kingdom; and the first is a metal. He says:

A metal is a simple fossil body that fuses and becomes fluid by fire; and by cold coagulates and hardens into a solid mass capable of distending under the hammer.

There are but six metals in all nature, viz.: Gold, lead, silver, copper, iron and tin. Some add mercury, but it does not agree with our definition in any respect. It is neither dissoluble by fire, malleable nor fixed. Yet the chemists hold that it is the basis of all metals, for by throwing in sulphur it becomes fixed into a metal. Hence as it is only a circumstance that is wanting to make quicksilver a metal, there is warrant for calling it by that name.

The symbols for the different elements used in those days were those which at present are used in our almanacs to represent the sun, moon and planets. It seems the metals had received a kind of apotheosis or translation into heavenly bodies. The explanation is somewhat as follows:

Sol, the Sun—Gold.

Luna, the Moon—Silver.

Venus—Copper.

Mercury—Quicksilver.

Gold is a circle because it is perfection.

Silver. This figure would be a perfect circle if the inner part were properly applied to the outer. Now the chemists all agree that silver is half gold; but the gold lies hid. And they say if you could turn the gold part outward, your silver would be converted into gold, and the crescent signifies as much.

Copper is a circle with a cross underneath, *i. e.*, Gold with some corrosive menstruum.

The cross was the symbol of fire, aqua fortis, vinegar, etc. As the cross was to crucify or torture men, so these things serve, so to speak, to torture gold into other metals.

Mercury, the sign for quicksilver, shows gold in the middle, silver at the top, and a corrosive at the bottom; accordingly all the *adepts* say of Mercury, that it is gold at heart, whence its heaviness; silver on the outside, whence its whiteness; but there is a pernicious corrosive sulphur adhering to it denoted by the cross. So if it were perfectly calcined and purified, and its color changed, it would be gold. Take away the corrosive and the silver, and the gold will be left. Hence that maxim on mercury: Strip me of my clothes, and turn me inside out, and all the secrets of the world will come forth.

He then takes up the subject of specific gravity. He says: The character of the air influences specific gravity. There would be great difference between the pure fine air of London or Paris and the grosser air in most parts of Holland.

The specific gravity of metals is very great, the lightest of them being more than six times the weight of water. Hence this might be added to our definition of a metal: it is at least six times heavier than water. This fact is very useful in the business of mining. If in digging you find a glebe or mineral whose weight is six times as great as water, you may safely conclude there is a metal therein.

In a discussion of the properties of elementary bodies, his remarks are of the following nature:

It was a common saying of the ancient chemists that *the* SUN *and* SALT *contain all things.*

The truth is, sea salt is a thing of so beneficial a nature that we had better be without gold than salt.

Because gold is so little influenced by fire, some have argued that gold alone has its just proportion of fire, and is itself no other than fire perfectly concentrated. Gold is not sonorous. Hence the chemists hold that whoever would convert another metal into gold, must first take away the sound.

People who work in quicksilver mines all die in a little time. One man after six years was so full of it that, holding a piece of gold in his mouth a little while, it became of a silver color and heavier than before.

With reference to stones, he speaks thus:

Stones are popularly divided into two classes, vulgar and precious; or, which amounts to the same thing, opaque and transparent. The distinguishing mark of precious stones, as of metals, is the weight. Whatever stone has the weight of a diamond is really a diamond.

He explained what we call "fossils," in the following manner:

Stones grow like plants. When the seed of a stone gets into a shell of an animal, it grows and is molded into the shape of the shell; for example, cornua ammonis, our ammonite.

The stones most opposite hereto, as chalk and boles, are little else than earth ill bound together by a very small quantity of crystalline juice. If this crystalline juice found its way in quantity into the midst of any concretion and evaporated, the result was an agate or onyx.

Under the head of sulphur he speaks of Arsenic:

The second is arsenic, the most fatal of the whole tribe. It destroys all animals and man as the name indicates: *Aner*, man, and *nikao*, to conquer. In an ancient MS. ascribed to the Sibyls is a verse which plainly indicates Arsenic:

Tetrasyllabus sum; prima pars mei virum, secunda victoriam significat.

Coral was considered a plant. Thus I might multiply examples; but I have already gone too far. Such were the lessons taught by "very learned" men about one hundred and fifty years ago! And yet I have heard people declare that the world was not advancing in knowledge; that there "was nothing new under the sun;" and such like expressions.

In conclusion take this—an item from physiological chemistry:

The component parts of animals are spirit, water, salt, oil and earth. Spirit is an oily or sulphureous matter so subtilized as to be volatile by the smallest fire, and miscible with water. That there is such a spirit and a peculiar one, too, in every man, is evident from dogs. They track any one man or beast among a thousand; ergo some specific matter distinguishes the dog's master from the effluvia of all others.

Hippocrates would indeed presently pronounce the sentence of death upon any one sick of an unknown distemper wherein the secretions were obstructed and the skin appeared squalid, dry and parched. But a chemist would go deeper into the thing and show you that the aqueous and spirituous parts of the blood being here wanting, the salts which are now rendered more corrosive and sharp, are brought by the laws of circulation to the fine tender vessels of the cerebrum and cerebellum, which they either wound or tear, or else prevent the secretion of animal and vital spirits therein; whence death must necessarily ensue, which is saying something that satisfies the mind and rationally accounts for the thing.

PHYSICS.

THE ELECTRIC TIME BALL AT KANSAS CITY.

BY THE EDITOR.

More than a year ago some correspondence was had between Prof. C. W. Pritchett, of Morrison Observatory, George H. Nettleton, President of the Union Depot Company, of this city, and the editor of the *Review*, in regard to the establishment of an electric time ball at the Union Depot here, which resulted in an agreement by Mr. Nettleton to furnish the necessary funds to put it in operation at once. But for some reason not made known, the managers of the Chicago & Alton Railroad, over whose wires the signals were to have been sent, failed to join in the enterprise, and it was dropped temporarily.

Within the past month or two the matter has been taken up again, and principally through the efforts of Prof. H. S. Pritchett, Dr. E. R. Lewis and Mr. T. B. Bullene, the scheme has been successfully accomplished. The city council appropriated a portion of the necessary money, and the remainder was made up by private contribution. The time ball and accompanying apparatus were placed upon the new building of Messrs. Bullene and Sheidley, corner of Seventh and Delaware streets, the tallest and one of the finest structures in the city; and on January 5, at exact noon, the first signal was given. Since then it has been of daily occurrence. Connection has also been made with the city engine house, on Walnut street, where the fire alarm bell gives twelve taps simultaneously with the dropping of the ball; also with an electric clock at the jewelry store of Cady & Olmstead, and with the forty telegraphic stations in various parts of the city; so that absolutely true time is now the rule. As this is the fourth city in the United States where such signals have been adopted—the others being Washington, Boston and New York—our citizens feel quite elated, as well as indebted to Professor Pritchett for inaugurating an enterprise which is of great service to us and no little trouble to him, especially since he makes no charge for his services.

To give our readers a comprehensive idea of the working of the electrical apparatus, we append some extracts from a communication to the Kansas City *Times*, by Prof. H. S. Pritchett:

"The need of accurate time increases, of course, in proportion, as the business of a country becomes more intricate. The business of the country is so vast and complicated, and all the adjustments of life are to be made with so much greater nicety, that accurate time is a necessity for every city—and especially for every business city.

"Before accurate time signals can be distributed, however, to railroads or cities, it is necessary in the first place to have good instruments for the determination of time and good clocks. It may be of interest to our readers to know something of the equipment of the observatory and the nature of the instruments upon which depends the accuracy of the time now being distributed each day to Kansas City.

"In the accurate determination of time there is necessary, in the first place, a good telescope, mounted firmly in the meridian, and known as a transit instrument. Fixed in the focus of this firmly mounted telescope are fine spider lines set perpendicular to the daily motion of the stars. The telescope being set upon a star, the daily revolution of our earth upon its own axis causes the stars to appear to move across the field of the instrument, and an observation of its transit across the threads of the transit instrument, after being corrected for the small instrumental errors, affords the most accurate means known for the determination of the clock errors, or, in other words, of the time. The standard clock itself is rarely changed, but its error is allowed to accumulate slowly from month to month. In sending the time, however, a different time-piece is used, which is compared with the standard clock just before the time of sending. In addition to the transit instrument and clock, most well equipped observatories of the present time are provided with a chronograph—an instrument for automatically registering by means of electricity both clock-beats and observations of star transits. The one in use in the Morrison Observatory was made by Alvan Clark & Sons, Cambridge, Mass., and the observations of transits are read off to the one hundredth part of a second, and time determinations are made to within that limit of error. The instrumental equipment used in Morrison Observatory time determinations is not surpassed by any observatory in America. The transit instrument itself is one of the largest and most firmly mounted. It is in most respects a duplicate of the instrument in use at the Royal Observatory at Greenwich, England, and was made by the same makers. Its cost in the shop in London was $4,500 in gold. The standard clock by Frodsham, London, and the chronograph, by Clark, cost in addition $1,000. These instruments—as good as can be made by modern scientific appliances—are capable of determining time as accurately as is possible in any observatory in the world, which may readily be distributed to any railroad or city in the west.

"The errors of the clock having been once determined, the distribution of correct time over the railroads and to telegraph offices is a very simple matter. In the method now pursued the local time is first changed into Kansas City time by applying the difference of longitude. At thirty seconds before 12 m., Kansas City time, each day, one of the break circuit clocks of the observatory is made to beat simply by turning a switch on the main line of the Western Union telegraph and the clock instantly commences to beat seconds in every telegraph office in Kansas City and along the line. At exactly 12 o'clock a double beat is given and the clock continues to beat till thirty seconds after, when it is shut off. The operators or any who may come to the offices to compare time-pieces, have thus three separate seconds which they can identify—the beginning second, which is thirty seconds before 12 o'clock; the double tick exactly at 12, and the last second beat, which is thirty seconds after 12. So that any astronomer or any clock maker in any town into which these signals go may easily compare his clock with the standard clock of the observatory once each day by simply carrying a watch or chronometer to the telegraph offices, taking the precaution to compare his watch with his regulator before and after.

"These signals are amply sufficient for all connected with railroads or who can readily go to telegraph offices. In order to furnish time to a large city, however, it is necesssary to establish some signal which may reach the majority of business men in or near their places of business. There are but two methods in use which have been found to be practicable and efficient. One is the firing of a gun by electricity at some moment previously agreed upon. The Royal observatory at Greenwich fires several time guns in this manner—one very large one at Edinburgh, which can be heard for miles around. There are several objections to this method which readily suggest themselves. If nothing else, the expense of purchasing and the danger of firing a large piece of artillery would prevent the adoption of such a plan in most cities.

"The second plan and the one most generally adopted, consists in the instantaneous dropping by means of electricity of a ball attached to a staff placed in the most prominent point accessible. The Greenwich Observatory drops a ball at Liverpool at one o'clock each day—the ball being so placed as not only to give the time to the city but also to the shipping in the harbor.

"The ball dropped at Kansas City, and which signalizes the first attempt of this kind in western cities, is equipped in much the same manner as the one in use in New York, the apparatus used in dropping it being simpler and more easily managed, and not liable to get out of order. The ball is dropped in the following manner: At just five minutes before noon the ball is hoisted into position at the top of the staff. It is held in place by a rope attached to an arm and supported by an armature of a relay on a local circuit, which is closed in turn by the relay in the main office at Kansas City, which is in direct communication with the observatory. The closing of the main circuit at noon causes the ball to drop—sliding instantly down the staff—the instant when it leaves the top being exact noon.

"There is another matter in connection with these time signals to which the business men of Kansas City might well give some attention. The observatory clock-beats go out over the lines and into the various offices of Kansas City one each day, and might be sent more frequently if needed. This is Kansas City time, and is as accurate as all the appliances of modern astronomy can make it, and its preparation costs time and labor. We are anxious therefore that it should benefit as many people as possible. Now these signals which go into Kansas City might just as well go into every railroad office of every road running into the city, and thus at the same instant the same clock would beat Kansas City time in every village of every road centering at Kansas City—from Omaha to Galveston and from the Mississippi to Denver. The thought itself is one very flattering to the enterprise of Kansas City, and its accomplishment would be of great material benefit to her. All that is necessary to accomplish this is to lead the different lines which already come into the same office into one relay, and it is accomplished at an expense of almost nothing. The wires could be so arranged that by simply turning on a switch two or three minutes before the signals are to come through, the clock-beats would go out on each line, and any interruption on one would not affect the others. The immense benefit to the railroads themselves, as well as to all business men generally, which would result from the adoption of such a system over the roads tributary to Kansas City, is almost incalculable—while all amateur astronomers who are in need of accurate time would be placed under lasting obligations. To bring about this result it is simply necessary for the managers of the roads centering in Kansas City to come to some agreement about the matter.

"At the last meeting of the American Association for the Advancement of Science held in Boston in August, the question of a uniform time system was brought up and a committee of astronomers was appointed to work up the subject for the ensuing year. Among the members of the committee were two of the astronomers of the Naval Observatory, the astronomers of the Cincinnati Observatory, Alleghany Observatory, Harvard Observatory, Morrison Observatory, New Haven Observatory, and others. Nothing definite was agreed upon, but one of the most favorable plans proposed by different persons was that which recommends the adoption of three meridians for the whole country, the time of the first meridian being from the Atlantic to the Mississippi, that of the second from the Mississippi to the Rocky Mountains, and of the third from the Rocky Mountains to the Pacific coast.

"Whatever plan may be finally adopted—and it is quite sure that with the constantly increasing railroad traffic some such general plan must be adopted in the course of time—there is no place better suited than Kansas City for distributing time to the whole of the Mississippi valley, and there seems to be no good reason why she should not inaugurate such a system as will make her permanently one of the great time centers of the country as she already has become one of its great business centers."

Since the adoption of the electric time ball signal at Kansas City, we observe that the people of St. Louis are moving in the same matter, and that at a recent meeting of citizens it was determined to raise $1,500 for the purpose.

MEDICINE AND HYGIENE.

MALARIA.

DR. W. B. SAWYER, KANSAS CITY, MO.

The term Malaria as applied by those outside the profession of medicine to disease is vague and often meaningless. It has been in certain localities quite the fashion to speak of many ailments of a more or less trifling nature as "malaria," and, with indifference to the appropriate use of terms, to call that a disease which is only a name for its cause. The primal and derivative signification of the word malaria is "bad air." Strictly speaking, however, all air vitiated by any substance poisonous in its action upon the body is bad air. The atmosphere of a closely packed audience room, loaded with carbonic acid, is clearly bad, while the stifling gases formed in the combustion of coal render the air of many family rooms anything but pure and good.

Malaria properly and in the signification given it by custom is an air poisoned by a definite something called miasm, the effects of which when taken into the body are manifested in a class of diseases of which "ague," or "chills and fever," is the type. Theories are numerous and discussion is endless as to the true nature of this miasm, but all theories and all discussions are based upon a few facts which the mass of human experience has shown to be incontrovertible. Leaving, then, to the medical profession to discuss the theories in detail as they are advanced, and to follow out minutely inquiries into the more scientific and difficult problems connected with the subject, there is still much to be learned in a broad and general way from the simple facts themselves.

In the first place this poisonous element exists in, and, under favoring conditions, emanates from the soil. At sea it is unknown or shows its presence only when a near approach to land brings it with the wind. Sleeping apartments on the ground floor are more often and more strongly contaminated than those above.

But though in and from the soil, it is only such soil as contains vegetable and perhaps mineral decomposing matter, and with the allied conditions of warmth and moisture. Marshy lands in warm climates are its most prolific sources, and in proportion as either one of the factors, water or heat, is diminished, so does its potency and virulence diminish.

The Pontine marshes and Jersey flats, in which latter locality an admixture of salt water seems to aid its generation, have always been covered with malaria, and similar tracts of moist country in warm latitudes are of like bad repute. Draining or flooding such a tract has an equally good effect in reducing miasm;

the former because one of the factors in its production is removed, and the latter because an excess of water either absorbs or prevents the dissemination of the poison. It follows also that high latitudes and high geographical elevations are less affected than the low, the other factor, of heat, being to a greater or less extent eliminated.

Stirring up soil that had previously been considered innocuous has in many cases, notably in parts of New York City, produced malaria from the exposure to sunlight and air of earth loaded with wet and effete matter; and, in the same way, withdrawing the water from lakes and ponds and its lowering in rivers give rise to similar results.

The noxious element gets into the atmosphere from direct contiguity, by wind currents, and by water courses in which it is carried, if not in solution at least in mechanical union, from one point to another.

Strictly speaking it is neither infectious nor contagious, and only produces its evil effects when taken into the body directly. It gains its access here chiefly through the respiratory process, though drinking water contaminated with it, or bathing in the same gives it some additional means of entrance.

When a person lives constantly in malaria or its neighborhood, especially if it be rich in miasm, disease is pretty sure to follow. Often, indeed, and perhaps usually, the trouble takes the form of some of the malarial diseases, so-called, whose chief characteristic symptom is a periodic disturbance of the heat-producing and regulating function. But it is a mistake to suppose that if this does not occur the system has become inured to miasm and tolerant of it. The whole constitution is more or less weakened and is rendered more easily a prey to every form of ailment; and when a sickness does come, if indeed it does not at once, no matter what its name or class, assume the malarial periodicity, it will give evidence by its greater virulence and obstinacy, of the evil influence that has gone before. Convalescence from even slight illnesses becomes slow and subject to relapses, and the appropriate remedies in such cases are found to be inefficient until fortified by the specific—and if any drug deserves the name, it does for malarial infection—quinine.

Woodlands are much more free from miasm than open country. This is doubtless due in a great measure to the drainage which the roots of large or thickly growing trees keep up, and possibly to the absorbing action of their foliage. The fall, too, the season when all verdure is dead or dying, and hence less actively engaged in its process of respiration, is the time when this poison is most prevalent. Doubtless also the mechanical action of foliage is a factor in the protective influence of trees, since a widespread shade must tend to hinder the formation of the evil principle and retard its diffusion. Night is more dangerous than day, since then the earth radiates the heat absorbed during the hours of light and with it sends forth its pestilential child.

Now, while no thinking person will undertake the care of his health without the advice of his medical man, when it is once clearly broken by this or any other cause, every one may, by taking heed to a few simple matters suggested by the foregoing cursory review, greatly diminish his risks. If within his power he may select for his permanent abiding place a northern latitude, a high elevation, and a region of well timbered country. This done, though he is fairly out of the circle of ordinary malarial influence and is comparatively safe, his security is still not absolute, as some cause unforseen and not easily forecast may be in operation even in these conditions. But should circumstances compel a residence in a suspicious locality, even more care should be exercised. The house should be upon high, dry ground; the land about it turfed and not subject to be deeply or widely stirred; the drainage good, and if possible into running water. Trees of good size and abundant leafage should surround the house, and if it is desired to do all that theory has suggested the Eucalyptus globulus may be planted. It has been thought to possess certain specific properties against miasm, though its good effects must be due in great measure to its wonderful activity as an absorbent of water. The house should be built with special reference to free ventilation and its plumbing perfected in every way possible to prevent the entrance of foul air from the main sewer pipes without. The sleeping apartments ought to be upon the second floor, and neither thickly carpeted nor hung with heavy curtains. In selecting a water supply, cistern or surface water may be avoided if possible, a deep, clean well in high ground being best and safest.

But of more importance than these matters even, is the care to be exercised by the individual over the details of his own bodily health. All the rules of hygiene necessary everywhere for the promotion and continuation of good health are of paramount necessity where, in spite of all precautions, the body is forced to sustain the presence of a dangerous and unhealthy element. Every function —those of skin, lungs, muscles, nerves and bowels—should be watched and kept in the proper condition of action and reaction by careful scrutiny and the habitual application of the appropriate stimulant for each. To get away from malaria is the best way to cure it and prevent it, hence a trip to the north or into the mountains once or twice a year, if for a few days or weeks only, may prevent altogether an incipient malarial fever, or render less severe and of shorter duration the customary fall attack of "chills." The night air should be shunned, the morning bath of cold or chilly water never forgotten; outdoor exercise, to the point of exhilaration but never of exhaustion, daily obtained; a selection of nutritious, well cooked food, not highly seasoned but made savory and to relish, eaten; some form of coarse food taken also from time to time, and the native fruits, when ripe, in their season, and imported figs, oranges, grapes and prunes in the winter months. Add to these precautions plenty of sleep and a clear conscience and the risk of malaria is reduced to the minimum.

BOTANY.

HISTORY OF THE VEGETABLE KINGDOM.

REV. L. J. TEMPLIN, HUTCHINSON, KAS.

In tracing the history of the Vegetable Kingdom to its origin, we are carried back through a long series of fossil forms till we reach a point beyond which these forms cease to record the existence of vegetable organisms. But here it is evident we cannot stop. As in the history of human nations, we trace it back through authentic history till this will carry us no further; we then resort to tradition till it can guide us no further and we are left to grope our way in the darkness of conjecture and speculation. So in tracing the history of plants, we finally reach a point beyond which the stony record cannot guide us by the light of fossil foot-prints. But we are assured that we have not yet reached the beginning of these organic forms, and we are compelled to resort to other modes of inquiry to approach nearer to the source which at best we cannot hope ever fully to reach. The earliest records of plant history have probably utterly perished without leaving so much as a trace of their existence behind. The oldest fossil plants are found in Lower Silurian rocks, and these, with one or two doubtful exceptions, are all marine plants.

Below what has generally been regarded as the oldest fossil bearing rocks—the Silurian—is an extensive formation known as the Laurentian system. Until quite recently these rocks were considered azoic in character; but quite recently what is held by some as a fossil animal has been discovered in rocks of this formation in Canada, where they are enormously developed. Wide difference of opinion exists among scientific men as to whether this *Eozoon Canadense* is really of organic origin, and much discussion has been the result. But whatever may be the fate of this much disputed form, which was probably only one of many forms of protozoa that existed at that early period in the world's history, we have very strong reasons for believing that organic forms did exist in great abundance at the time these rocks were deposited. As the animal system is incapable of digesting or assimilating inorganic matter, it is wholly dependent on the organizing agency of the vegetable kingdom to organize the elements of earth, air, and water, into forms that will build up and repair the wastes of the animal system. From this consideration it is evident that plants must have preceded, or, at least, have been contemporary with the earliest animal existence. The existence of animals would, therefore, prove the parallel existence of plants, even in the absence of all other evidence of this fact.

If the animal nature of the *eozoon*, referred to above, be admitted, the existence of plants at the same time is established. But we have other proofs of the existence of plants during the period of the deposition of the Laurentian rocks. The first of these is the existence of extensive limestone deposits as forming a part of the rocks of this formation. These limestones are in the form of marble, but all the rocks of the Laurentian system are highly metamorphic. These limestone beds are of great thickness and of vast geographical extent. Three bands of these, varying in thickness from 60 to 1500 feet, have been traced in Canada for more than 100 miles, and they are doubtless of much greater extent.

It is almost universally conceded that limestones, in all ages of the world, are of organic origin, having been built up from the stony forms of polyps and the shells of mollusks and crustaceans. That this is the manner in which the limestones of later ages have been built up does not admit of question, and we know of no good reason for assigning any other origin to those of this very early period. If, therefore, these extensive beds of limestone were produced by animal agency, it would necessarily demand the contemporaneous existence of enormous quantities of vegetation. Another fact that seems to demand a similar cause for its explanation is the existence of large quantities of carbonic acid in combination with the lime in these rocks. There is strong reason to believe that all carbonic acid originally existed in the air, as we find it still so existing to the extent of about .04 per cent. It is through vegetable agency that this gas is abstracted from the air and fixed in a solid form. It is held in this form till by the decay or combustion of the organic substance it is liberated again to enter into the atmosphere in a gaseous state. It was doubtless through vegetable agency that this substance was withdrawn from the air that it might be laid up in the stones. Admitting the correctness of this view, it would indicate a very abundant vegetation during the time these rocks were forming. That these limestones were of organic origin is further rendered probable by the fact that they are associated with hydrous silicates; especially serpentine and loganite, which may arise from the facility with which silica combines with bases in the presence of organic matters, or from the abundance of soluble silica in the hard parts of diatoms which probably formed the chief food of those animals that build their own skeletons of carbonate of lime. These facts create an almost irresistible presumption that the limestones of this period were of organic origin, which, if true, proves beyond question the prevalence of plants at, and probably long prior to, the time of their deposition.

A second indication of the existence of vegetation during the Laurentian period, is found in the existence of abundance of carbon besides that which exists in combination with lime in the limestones. This is found in the form of graphite or plumbago. This is simply one stage of coal, having probably existed in the form of ordinary coal at an earlier period of its existence. Coal exists in all degrees of carbonization, from the poorest quality of lignite to the pure substance in the form of graphite. The various stages of progress through which this process is carried on are indicated by lignite, bituminous and anthracite coals and graphite. The stage reached seems to depend on the extent of metamorphic agencies to which it has been exposed. In those regions, as in Northern Kansas, where the heat and pressure have been very limited, we find an impure lignite; in those places, as the Western coal fields, where these agencies acted with greater but yet with moderate energy, the coal is bituminous; while in others, as in the Appalachian coal beds, where these metamorphic forces have operated with intense power, the coal is of that compact, highly carbonized character known as anthracite. But where the heat has been intense enough to fuse the rocks and the pressure so great as to force out all the lighter gases, leaving only the pure carbon, it becomes graphite. That this is the process by which graphite has been formed is evident from the fact that in the vicinity of fissures where the heat has been intense enough to metamorphose the rock, the bituminous coal has been changed into anthracite, and anthracite has passed into plumbago. Thus, at Worcester, Mass., a bed of graphite and pure anthracite occurs, interstratified with mica schist. It has been employed for both fuel and lead pencils. Thirty miles from this, in Rhode Island, an impure anthracite is found, containing impressions of leaves of coal plants. This is intermediate between the anthracite of Pennsylvania and the graphite of Worcester. From these facts it appears that graphite is only an extreme metamorphic condition of coal. When, therefore, we find large deposits of graphite in highly metamorphic rocks of the Laurentian period, the conclusion is irresistible that vast quantities of vegetation must have existed at the time they were laid down.

Still another evidence of the same fact is found in the existence of iron ore in these rocks. It appears that iron originally existed in a distributed condition in the clays and other rocks of the earth. Thus we find where iron ore deposits are found, the iron has been leached out of the adjacent rocks and they are destitute of any red color, while in red colored rocks, the iron still being distributed through them, no beds of ore appear. When the iron has been so taken from the rocks and gathered into deposits, it appears either in the form of ferric acid or carbonate of iron. We see this process in operation at the present day in the formation of bog iron ore. The manner in which this iron is collected is of much interest in connection with the question of the existence of vegetable matter in the adjacent rocks, for it will appear that such matter is an important agency in producing such deposits. The iron as it exists diffused through the rocks and soils is in the form of peroxide of iron, or ferric oxide, which is insoluble in water, and consequently cannot be washed out by percolating waters. Some deoxodizing agent is needed to bring about this result. This is found in decaying vegetable matter. Such decay is an oxidizing process, and when it takes place in the presence of peroxide of iron, the effect is to deoxidize it, reducing it to protoxide, by combining with a portion of the oxygen held in combination by the iron. Carbonic acid then combines with this protoxide, forming carbonate of iron, which, being soluble, is dissolved by percolating waters, which come to the surface as chalybeate springs. But when these chalybeate waters come to the surface, and are exposed to the atmosphere, the iron reabsorbs oxygen, and is converted back to peroxide, which is deposited at the bottom of any basin where the waters may be retained for a time. But should there be an excess of decomposing vegetation present, as in peat bogs, this reoxidation cannot take place, and the metal is deposited in the form of carbonate of iron. The former of these methods is the more usual, though the latter is not infrequent. But the existence of iron ore in either of these forms proves the existence of vegetation at the time of its accumulation. Now, the Laurentian period was remarkable for the extensive beds of iron ore that were accumulated in its rocks. The vast deposits of iron found in the Iron Mountain regions of Missouri, the Lake Superior regions of New Jersey, and Sweden, all are found in the rocks of this period. Now, taking the above facts, either singly or in combination, they seem to establish beyond a doubt the existence, even during this time, of enormous quantities of vegetation, although not a vestige of it may exist in the form of fossils at the present time. The fact of the disappearance of all these organic forms may be easily accounted for in the extremely fragile character of all those primitive organisms. And while the above are only circumstantial evidences of their existence, they are of such a nature as to carry all the weight that belongs to ordinary direct evidence. We conclude, therefore, that the existence of limestones, graphite and iron, in the rocks of the Laurentian period, prove the existence of vegetation during the time of their formation, while the enormous extent of their existence is to be taken as the measure of its abundance. While we are thus positive of the existence, during the early period, of vast quantities of vegetable matter, in regard to the form in which it flourished we are left entirely to conjecture. But of one thing we are assured, and that is that no land plants existed at that day, for the very good reason that no dry land had yet appeared above the universal ocean that covered all the face of the whole earth, and consequently this class of vegetation could not have had any influence in bringing about the above results. All the vegetation of that age was doubtless of that simple yet extensive class of marine plants known as fucoids. The Archæan age, of which we have been treating, was followed by the Silurian; but, between the closing of the former and the beginning of the latter, there seems to have been a considerable lapse of time of which we have no record. As to the length of this unrecorded time, or as to what did or did not take place during its lapse, we are left wholly to conjecture, and the assumption that great changes had taken place in the organic development of higher from lower specific form, is a begging of the question, inconsistent with scientific methods of inquiry. With the incoming of the Silurian age, there was the sudden appearance of a wonderful variety of somewhat highly developed living organisms, especially of the animal series. The fossil remains of more than 10,000 different species of animals have been discovered in the rocks of this age, and others are almost constantly coming to light. Every class of the animal kingdom, except vertebrates, was numerously represented in the fauna of that age, while the individuals belonging to many of these species was above computation or even conception. Now some of these, as the Trilobites, that came in with the very beginning of the age, were of highly specialized types. I do not say that these were not evolved from the low, protozoan types, that probably existed during eozoic times. I do not know how they were introduced. It may have been by evolution, but of this we have no evidence worthy of being called scientific. But, according to a principle already stated, we know the existence of such an extensive fauna demanded an enormous development of the vegetable kingdom to furnish, either directly or indirectly, sustenance for the numerous animals that thronged the Silurian seas. Unlike the previous age, we have in the rocks of the Silurian age numerous fossil vegetables, not only furnishing positive proof that they existed in that age, but also giving us an idea of their forms and structure. The plants of this age were, with very few exceptions, marine algæ. There are a few examples of land plants, the remains of which have been found in rocks belonging to this age. Recently two fossils from the lower Silurian in Ohio have been described as land plants of the genus Sigillaria; but the correctness of this conclusion has been called in question by very high authority, so that they are not to be permitted, for the present, to testify to the existence of such highly specialized plants at that early day. The only objection to giving these fossils their high position is their lack of decided characteristics to justify their claims to such honor. The remains of what are claimed to be land plants have been found in the rocks of this age in Sweden. All geologists claim that they are not algæ, and they are referred to as vascular cryptogams and monocotyledons. If this be their true character, we have here, even in the lower Cambrian, quite highly developed land plants. The trouble with all these specimens is, they are so void of distinguishing characteristics that we are liable to mistake a Thallogen for some of the more highly differentiated orders of plants. In Scotland there are traces of the remains of land plants in the lower Silurian; but their characteristics are not very positive, and, at best, they must have belonged to some humble class of endogenous plants. Undoubted land plants have been found in Canada, where, with a large number of fucoids, a few specimens of club-mosses have been discovered, that are referred to Prof. Dawson's genus *Psilophyton.*

In these both the fibrous bark and the scatariform axis remain and serve to guide to a proper classification. Such are all the evidences known of the existence of land plants during the Silurian age, and it must be confessed they are exceedingly meager, though in view of the fact that there was a large V shaped tract of land above the ocean between what are now the St. Lawrence river and Hudson's Bay, it is extremely probable that during the long time that intervened between the elevation of this land and the close of the Silurian age many land plants flourished, considerable numbers of which would be floated off and buried in the sediment of the Silurian seas. Much of this doubtless remains to be discovered. Next above the Silurian comes the Devonian Age in which, in addition to the humble plants noticed above, we find those of higher organization and more complex structure. These include all the orders of vascular cryptogams, viz: ferns, lycopods and equisetae. The Ferns were represented by a number of genera, as Cyclopteris and Neuropterous; the Club-mosses by the Psilophyton introduced at an earlier time, and also by those giant vegetable organisms that prevailed to such an extent during the following age--the Sigillarids and Lepidodendrids; and the Equisetae by Calamites and Asterophyllites.

And here, in this early age, and certainly long before we should expect them according to the hypothesis of evolution, first appear true gymnospermous trees (*Conifers*), in the genus Protaxites. The true coniferous character of these trees is proved by the well known gymnospermous tissue and concentric rings of growth.

These were not simply shrubs, but trees of good size; some having been found eighteen inches, and others even as much as three feet in diameter.

It seems somewhat difficult to understand how, according to the doctrine of evolution, these highly differentiated organisms should appear at so early a period, and with so little preparation, in any of the forms that are known to have preceded them. These advanced forms would seem to indicate that if produced by evolution, it must have operated by "jumps" and not by "gradual modification," or as some have it, "That the steps of evolution were just at this point somewhat rapid."

While such assumptions are purely gratuitous, it is admitted they are absolutely essential to the existence of the theory. A large number of Devonian plants have been found; fifty or more species having been discovered in Nova Scotia alone. The sudden appearance of such a numerous and highly developed flora at the beginning of this age, is difficult to account for in harmony with the doctrine of evolution, except by the position assumed above of extraordinarily rapid advance at special times, or of a lapse of immense time between the close of the Silurian and the beginning of the Devonian ages. Either of these hypotheses might answer, but unfortunately neither has any foundation of proof on which to rest.

(*To be continued.*)

ASTRONOMY.

ANCIENT ECLIPSES.

WM. DAWSON, SPICELAND, IND.

EXTRACTS.

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Our most ancient record of an observed eclipse is found in Chinese history as having occurred in the reign of Emperor Chow-Kang. A little uncertainty still exists as to the exact time when this solar eclipse took place, but the most probable date is that of October 13, 2127 B. C.—about 4,007 years ago. On

Assyrian tablets in the British Museum, is found a record of a solar eclipse, total at Nineveh, June 15, 763 B. C. Uzziah, king of Judah, and the prophet Isaiah both flourished about this time It was also near this date that the shadow went back on the dial of Ahaz. One of the most interesting and important eclipses of ancient times is the one predicted with the saros by Thales, of Miletus. It occurred May 28, 585 B. C., and put an end to a long and bloody war between the Medes and Lydians. A battle was raging high near two hours before sundown of that eventful day, when the sun was suddenly darkened and day turned into gloomy night. This great change in the face of nature produced such an impression on the contending armies that they were both anxious to make peace, which was confirmed by a twofold marriage, in order to make it the more binding, "For without some strong bond there is little security to be found in men's covenants." The exact time and spot on the earth where this noted battle took place was for many ages a matter of doubt and contention among historians. But the accuracy of modern computations has settled the date (B. C. 585, May 28th, in the evening), and pointed out Asia Minor, near the northeast corner of the Mediterranean as the place.

About five and a half centuries before the Christian Era a king besieged the Median city of Larissa. The Medes held their own full well for sometime; but in 557 B. C., May 19, an eclipse of the sun so overpowered them that they gave way, and the Persians took the city without further trouble. A total eclipse of the moon, recorded by Pliny and Plutarch, occurred September 30, 331, B. C., eleven days before the celebrated battle of Arbela, in which Alexander gain ed a signal victory over Darius. There was a partial eclipse of the moon about two or three hours after midnight, March 13, 4 B. C.; and also a total lunar eclipse near midnight, January 9, 1 B. C. Now according to Josephus, the the death of Herod took place about the time of one of these eclipses, but which one does not seem very clear, as (it is said) he only speaks of one eclipse in all his writings. Herod died a short time, probably three months, after the birth of Jesus Christ. Hence it would seem uncertain whether our Savior was born about December 13, 5 B. C., or October 9, 2 B. C. It has long been supposed that his birth preceded the Christian era by four years. Although there seems to be evidence in favor of the latter eclipse, making the birth of Christ early in October, 2 B. C., yet it may be safer to adopt the eclipse of March 13, 4 B. C., as the one to which Josephus alludes, and consequently the date December 13 (or probably 25) as being the time of birth of Christ. It has been claimed by some that an eclipse of the sun caused the darkness which attended the crucifixion of our Lord; but that event occurred at the time of full moon, and, of course, there could be no eclipse of the sun. Besides, the darkness continued many times longer than that of a solar eclipse.

An eclipse of the sun which was central and total some distance north of Jerusalem occurred November 24, 29 A. D. And on January 1, 47, a total eclipse was seen at Rome, and it is said in the same night an island rose up in the Ægean sea.

It being my purpose to give some account of a few of the most interesting eclipses among the many that have been seen and recorded in the past; I wish to mention a few in the earlier and middle ages of our own era. A total eclipse passed over Northern Italy in A. D. 237, April 12. "So great was the eclipse of the sun that people thought it was night, and nothing could be done without lights." During a total eclipse of the sun July 19, 418, not only stars became visible, but a great comet was discovered, which continued visible for four months afterwards. In 810, May 5, a total eclipse of the sun frightened Louis "the pious" emperor of the West. He died a little while after it, and seems never to have recovered the fright he received from the eclipse." A total solar eclipse came over London in the time of King Alfred, 878, October 29, at 1:16 P. M. It was not till 1715, after the long interval of 837 years, that another total eclipse of the sun occurred at London. An eclipse of the sun was observed at Cairo, December 13, 977; and another at the same place June 8, 978. A comparison of these two eclipses with the dates of some others seem to prove that the moon's orbital velocity is now a little faster than it was in ancient days. In other words, that it revolves around the earth in rather less time than it did in former ages. In 1033, 29th of June, a solar eclipse is described by a writer of the time as "exceedingly terrible, for the very sun became of a sapphire color." Computation indicates a great eclipse of the sun in England, August 2, 1133, which was considered a presage of misfortune to Henry I; and is thus alluded to by William of Malmesbury: "The elements manifested their sorrow at this great man's last departure, for the sun, on that day at the sixth hour, shrouded his glorious face, as the poets say, in hideous darkness, agitating the hearts of men by an eclipse." A great earthquake with horrid noise and a sinking of the ground is said to have happened about this time. But other accounts say that Henry died in 1135, December 1st. I look at both records (the eclipse and history) as high authority, and in this case feel quite unable to decide which is correct. On May 14, 1230, a total eclipse of the sun near sunrise seemed to prolong night into day. An eclipse of the sun was total in the south of France, January 1, 1386. A noted eclipse of the sun passed over Scotland June 17, 1433. The totality continued long at Edinburg about 3 in the afternoon. It was called the "black hour" for many ages afterward. In 1598, February 25, in the morning, was another total eclipse of the sun at Edinburg, and for generations following it went by the name of "Black Saturday." In 1560, August 21, a total eclipse of great duration occurred at Coimbra, Portugal, about which is said: "There was darkness greater than that of night; the stars shone very bright in the sky; women screamed and cried out that the last day of the world had arrived; and the birds fell down to the ground in fright at such startling darkness."

An account of the Columbus eclipse will be given in the words of another: "An eclipse of the moon which happened on March 1, 1504, proved of much service to Columbus. His fleet was in great straits owing to want of supplies, which the inhabitants of Jamaica refused to give. He accordingly threatened to deprive them of the moon's light as a punishment. His threat was treated at first with indifference, but when the eclipse actually commenced, the natives, struck with terror, instantly commenced to collect provisions for the Spanish fleet, and thenceforward treated their visitors with profound respect" and plenty of food.

From a list of eighty solar eclipses already computed for England, I select a few which will be very large, and many of them total. In the early morning of August 3, 1887, a total eclipse in Germany and eastward. "The lovely orb of day having risen upon the summer scene, will appear to sink back into the arms of night, while the stars of heaven resume their twinkling." Another in 1900, May 28, 4 P. M.; 1905, August 30, 1 P. M.; 1912, April 17, at noon; 1927, June 29, 5 P. M.; 1951, February 15, 7 A. M.; 1999, August 11, near noon; 2026, August 12, 6 P. M.; 2081, September 3, 8 A. M.; 2093, July 23, noon; 2135, October 7, 8 A. M.; 2151, June 14, 6 P. M. In the twenty-third century a large total eclipse of the sun will occur every nine years, in the month of May, from 2227 to 2254.

In just 500 years from July 21, 1881, there will be a fine solar eclipse soon after 10 in the morning.

Whether or not the present economy of worlds be continued for thousands of years to come, "of this we may be certain, that as the phenomena we have described have excited men's marked attention from the earliest days, so they will continue to do till the end of time."

ASTRONOMICAL NOTES FOR FEBRUARY, 1881.

BY W. W. ALEXANDER, KANSAS CITY.

The Sun on the 1st will rise at 7 h. 10 m. a. m., pass the meridian at 00 h. 13 m. 55.24 s. p. m. and set at 5 h. 17 m. p. m., and on the 28th it will rise at 6 h. 38 m. a. m., and pass the meridian at 00 h. 13 m. 36.80 s. p. m. and set at 5 h. 47 m. p. m.

Mercury on the 1st will pass the meridian at 00 h. 36 m. p. m, and set at 5 h. 39 m. p. m. On the 28th it will pass the meridian at 1 h. 6 m. p. m., and set at 7 h. 09 m. p. m. The 22nd presents a very favorable time to see this planet, it being 18° 08′ east of the Sun.

Venus on the 1st will pass the meridian at 3 h. 07 m. p. m., and set at 9 h. 07 m. p. m. Its apparent size and brilliancy are fast increasing. During this month it may be seen by a good eye in daylight, if the atmosphere is clear. About 3 h. p. m. it is in the south and in the best position to be seen. On the 22nd it is in conjunction with Jupiter, being 3° 20′ north of that planet.

Mars on the 1st will rise at 5 h. 33 m. a. m., and will pass the meridian at 10 h. 11 m. a. m., and on the 28th it will rise at 5 h. 00 m. a. m., and will pass the meridian at 9 h. 51 m. It is quite small and difficult to find.

Jupiter on the 1st will pass the meridian at 4 h. 08 m. p. m., and set at 10 h. 24 m. p. m., and on the 28th it will pass the meridian at 2 h. 41 m. p. m., and set at 9 h. 04 m. p. m. On the 22nd it will be in conjunction with Venus, passing south of that planet 3° 20′.

Saturn on the 1st will pass the meridian at 4 h. 41 m. p. m., and sets at 11 h. 04 m. p. m., and on the 28th it will pass the meridian at 3 h. 04 m. p. m., and will set at 9 h. 30 m. p. m.

Uranus on the 1st will pass the meridian at 2 h. 11 m. p. m., and on the 28th at 0 h 21 m. a. m.

Neptune on the 1st will pass the meridian at 5 h. 49 m. p. m., and on the 28th at 4 h. 4 m. p. m.

The Moon on the 2nd is in conjunction with Venus, passing north of that planet 5° 28′. On the 3rd it will pass Saturn and Jupiter. On the 5th it will pass Neptune and will be in conjunction with Uranus on the 15th. It will also pass Mars on the 25th.

METEOROLOGY.

CLOUDS.

PROF. BY S. A. MAXWELL.

In this article I propose to say a few words concerning *popular errors* in reference to clouds and storms. The first of these which I shall notice is the so-called *return of a storm*, after it has passed. Some people tell us that a storm frequently makes a retrograde movement, *i. e.* having passed in an easterly direction, it stops, changes its course, and returns toward the west. Now I do not wish to dispute any one, for I do not know what persons may have seen in other lands, but, so far as our locality is concerned, this particular phenomenon has never occurred during the last fifteen years. I know that many times there appears to be such a motion; but such motion is apparent, not real. After a shower has passed there is very often a large area in the track of the storm, over which are floating clouds which are just ready to discharge their vapors in the form of rain. These clouds suddenly begin to precipitate rain, and the casual observer would remark, that the storm was returning from the east. Let those who harbor the idea that a storm ever retraces its course, please to observe in which direction the clearing up commences and the sky first appears; in all cases it will prove to be very nearly in the same direction as the storm came up. The deception is often rendered still more complete by the direction of the wind; and this leads us to the consideration of the *second error*, which we shall notice, viz.: that the *direction of the wind at the earth's surface is not the same as in the higher regions of the air*, where the storm clouds float. It is a very common belief that the snow storms, called Northeasters, come from the northeast; but it is the surface wind only which comes from that direction; the storm-clouds themselves always moving from the west or southwest. This fact has been known to scientific observers ever since the researches of Benjamin Franklin established it as a fact. A storm of this character which rages one day in Missouri or Iowa will, on the next, be found in the regions of Lake Erie. Numerous cases like this have been noted in the *Weather Review*; and what is perhaps the main point to be observed is, that no record has yet been made of any great storm moving in the contrary direction *i. e.*, from the east or northeast.

Another error which deserves notice all the more, since meteorologists of some repute hold to it, in common with the general public, is, that tornadoes which occur on the same date are identical; for instance, it is maintained that the Marshfield tornado and the one in Southern Illinois on the same date, were one and the same. Now, though these occurred less than four hours apart in point of time, it is hardly probable that they were identical, since the localities where they occurred are so widely separated that a storm could not possibly have passed from one to the other in so short a space of time; and further, since another storm happened the same afternoon in Kentucky, and still another in Northern Illinois, it looks more as if there were certain physical conditions operating, which made tornadoes possible; and, indeed, this was the case throughout a large portion of the Mississippi basin. These conditions were in brief:

1st. Low barometric pressure.

2nd. High temperature.

3rd. Strong southerly winds.

4th. Probably, favorable electrical conditions.

These are the combinations of circumstances which produce tornadoes, and are seen to co-exist on days when these storms are numerous; as on May 6, 1875, when there were tornadoes in Kansas, Missouri and Illinois, or the date of the Mineral Point storm, on which day numerous similar storms were reported from different localities.

These facts seem to prove that tornadoes are the result of certain atmospheric conditions, and that they are not necessarily identical, even though they occur on the same date, and at places not very distant from one another.

MORRISON, Ill., Jan. 8, 1881.

THE WEATHER PROPHECIES (?) OF VENNOR.

ISAAC P. NOYES, WASHINGTON, D. C.

A person who makes himself so conspicuous before the world as Mr. Vennor has done during the past year by his attempted prophecies of the weather, must expect to invite criticism; especially so when his pretensions are so at variance with science and common sense.

In the absence of facts it is not surprising that there is great ignorance—be the subject what it may. Only within a few years have sufficient facts been obtained to enlighten us in regard to the weather. These facts have all been gathered and put into shape by our complete Weather Bureau, and are daily spread before us on the Weather map. He who will learn to read and understand this simple yet wonderful contribution to the scientific knowledge of the world will see more and more beauty and wonder in the works of nature than was ever dreamed of in the days of the old Farmer's Almanac. With all this we have a man now attempting to revive and compete with the old Farmers' Almanac—endeavoring to make the people believe that it is something wonderful to guess what the weather will be months in advance. If this man would only come out boldly and proclaim that his efforts are all guess work, founded upon the weather of previous years, and say that from facts recorded there is a possibility of the weather repeating itself occasionally, and therefore we may possibly, at a certain time, have a certain kind of weather, all well and good. But the weather does not repeat itself wholly. There is a similarity at times, but nothing regular enough to warrant any fixed statement that can be depended upon.

The storms which have occurred in the United States the last half of this month, December, 1880, well illustrate and may well be taken as a good example of the dependence that may be placed on the weather prophecies (?) of Mr. Vennor.

If the public were better informed as to the laws governing the weather of the globe, instead of creating a surprise that so many have faith in such statements and claims, the surprise would be that any man of scientific knowledge would have the least respect for them, at least unless Mr. Vennor world distinctly put them on the basis of mere guess-work and let them be understood to be such. It is no new thing, nor anything patented to Mr. Vennor, that there is a similarity between the weather of the months of the different years; but though there may be this similarity in the weather, it never wholly repeats itself. Yet, with all this, people wonder, and even demand, why the U. S. Weather Bureau does not compete with this man. If people will only study the Weather map sufficiently to understand the laws that govern the weather, they will readily tell why. But this they will not do, but, instead, prefer to remain in ignorance, and then foolishly demand of the Weather Bureau a physical impossibility. The Weather Bureau could *guess* at the weather for ten or even a hundred years ahead; but suppose they should attempt it, would these people be one-tenth as charitable toward it, as a government institution, as they are now toward a private individual? One can safely say that they would not be. Then no sensible man, with full knowledge of the laws of meteorology, would want to attempt such a thing, for he well knows that there is no certainty in the weather of different years repeating itself. There may be a similarity, but that is all.

Mr. Vennor pretends to forecast the weather. His pretensions consist in statements as to great storms and very general comments as to what will be. Does it not strike sensible men as absurd that a man should only be able to foretell great snow storms and great commotions generally, and not specifically?

Would it not seem that if he *knew* anything about the weather, he would not only be able to tell for every day in the year, but for every locality—say for every square of fifty or a hundred miles—and able to tell it every time. What would the public think of a doctor who was only able to treat a few of the most difficult complaints and quite ignorant of the human system and the great majority of the ordinary diseases which afflict the human race? Able to treat severe cases one day and unable to treat them the next? It would seem that if a doctor was able to treat phthisis and typhoid fever, he would know a little about measles and be able to treat patients for boils and colds. It would seem queer if a person regarded as a scholar knew only a few "big words" and was quite ignorant of the ordinary words used in every day life, and only knew these "big words" at times. What would we think of a person who pretended to be a teacher of geography and could only impart information in regard to a few of the largest rivers and mountains of the world, and knew nothing about the geography of every-day life?—would not know in which direction to travel to reach Chicago, St. Louis or New York? It is impossible to imagine such a teacher holding any rank in society or commanding any influence among his fellow men.

What would the captains of the ocean steamers think of a man who pretended to tell them what kind of weather they would have every voyage? To be sure, a person might make a study of voyages and the months of the year and venture a guess, but even then he would be no wiser than the captains and their crews. No captain would be foolish enough to put faith in such forecasting of his voyage, for he knows very well that, though the voyages of the same seasons may resemble each other, they are not wholly alike. But if he could have daily communications from all about him while on the voyage, and from day to day, or at times, receive information for three or four days in advance, he would have something that would be of advantage to him. But this, at least at present, is impossible to have on the sea, but its equivalent we do have on the land. We have stations all over the country. The information is collected at a central point and then distributed over the whole country for the benefit of all. This information can only be gathered from day to day—it cannot be gathered in advance; still oftentimes we have the weather for three or four days ahead quite well defined or indicated. This does not always happen and cannot be depended upon, neither can dependence be placed in the idea that it will repeat itself; for it never wholly does so. It may in part, but if we cannot have it complete, what use is there in a mere similarity in parts? The dissimilarity of other parts will change the face of the whole. This fact is evident every day. We often times have a weather map similar for different days, but the dissimilarity makes quite another thing of the weather of the United States as a whole.

Because it was reported that Mr. Vennor "prophesied" that we were to have an immense snow storm generally over the United States on the 22d of December, the storms that have passed over the country from the 16th to the end of December are credited to him. The storm of the 17th was telegraphed over the country from Chicago, "Vennor's storm coming," and people who do not know any better think that all the storms that have passed over the United States since the 16th inst. are only parts of "his storm." On the 16th of December *Low*, or the storm center, was in the Indian Territory and Texas. On the 17th it moved over Missouri and Arkansas, and on the 18th passed off the North Carolina coast. The results of this storm were very light snows north of the Ohio river, Iowa to Ohio, and to the south light rains, and very light snow on the 18th in the North United States and Canada.

On the 19th a new *low* in the Southwest: It followed a usual course and yet not a fixed course. As it advanced it took nearly a northeast direction, and passed off the coast on the 21st with the center about on a line with the mouth of the Chesapeake Bay. This, of course, caused an area of snow-fall within a circular line, taking in the southern part of Connecticut, sweeping around to Maryland and Virginia. It was not general throughout the United States. It was not what might be termed a very heavy fall of snow—nine inches on a level is all that can be claimed for it at Washington, and hardly that.

To all fair-minded persons it would seem that a fair interpretation of the "prophecies" would have been to have had even a heavy fall of snow generally over the northern portion of the United States and Canada. Instead, the area of this storm was very limited, being confined to a very small section of the United States along the Atlantic coast, and was all over before the day claimed for it, and a new one on the way. On the 24th a new *low*, or storm center, developed in Central Southern Mississippi. On the 25th it moved to the North Carolina coast and thence up along the Atlantic coast toward Boston, where, on the 27th, about nine inches of snow fell; thence this area of *low* passed off the coast and toward Nova Scotia. It will be seen that the track of this storm was similar to the one that preceded it and produced similar results, yet not extending into the interior as far even as the other; merely touching the coast—yet a good example of how one storm may resemble another and still not produce the same results.

On the 28th still another *low* passed over the Gulf, and on the 29th disappeared, northeast into the Atlantic, giving rain on the immediate South Atlantic and Gulf coasts, and snow in the interior, and light snows thence to the Ohio Valley and New Jersey. With all these snow storms very little fell generally throughout the United States. Most of the snow fell in and about the immediate Atlantic coast from Boston to Washington, while in Maine, and even in the eastern parts of Canada, it has been relatively warm, with rain; at Providence, R. I., very little snow, none to speak of at Albany, and very little throughout the West. While these snow storms were mostly concentrated, as here stated, along the Atlantic coasts, the temperature was warm in upper New England territory and Eastern Canada, while it was severely cold all to the west of these storm centers, generally over the United States and Western Canada, and even at times to the extreme South.

The simple reason of this was that, as heretofore stated in these papers, the wind is always toward the center of the area of low barometer. As all of these *lows*, excepting that of the 16th to the 18th, traveled on a low line of latitude, the wind was generally from the north—that is, from the north at first and then from the west and northwest. This continuing for so many days created an intense cold throughout the greater portion of the United States and Canada, the *northeast corner* being the only warm section of the country for the time being.

As to the hitting of dates when a storm will pass over the country, when it is known that an area of low barometer generally passes over the United States from every three to four days, it is not at all surprising that one may venture a guess and get within a day or two of when a storm will pass over some portion of our vast territory. Then this is the season of snow storms for the Northern Hemisphere. Because we have had these snow storms, thoughtless people in the neighborhood where these storms have occurred give all the credit to Mr. Vennor. Suppose these same people lived in Maine, New York State, or anywhere in the West, north of the Ohio Valley, where they might have expected snow and had none to speak of, what would they think of prophecies which were not fulfilled any better for their vast districts? Nothing can be more absurd than these attempts at forecasting the weather. There is nothing certain, scientific, or reliable about it.

If Mr. Vennor will go back to the "first principles" and tell us where the storm center will be months in advance, then we will think that he has some superior knowledge; but until he can do this he had better not venture any more guesses in regard to the effects which follow these first principles.

WASHINGTON, D. C., Dec. 31, 1880.

METEOROLOGICAL SUMMARY FOR THE YEAR 1880.

FROM OBSERVATIONS TAKEN AT LAWRENCE, KANSAS, BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

The year 1880 surpassed all previous years of our record in the warmth of its January, the coldness of its November, its maximum monthly and hourly velocity of wind, and the earliness of its spring and winter. Maples were in blossom February 11th, and genuine winter weather began November 11th, continuing without interruption to the end of the year.

The temperature, wind velocity and relative humidity were *above*, while the the fall of rain and snow and the cloudiness were *below* the annual averages.

The most remarkable meteorological event of the year was the wind storm of March 27th, which filled the air to a great height with an almost impalpable dust, and obscured the sun during the entire day after 10 A. M.

Mean temperature of the year, 54.01 deg., which is 0.72 deg. above the mean of the twelve preceding years. The highest temperature was 101 deg., on August 18th; the lowest was 12 deg. below zero, on the 29th of December, giving a yearly range of 113 deg. Mean at 7 A. M., 48.10 deg.; at 2 P. M., 63.55 deg.; at 9 P. M., 52.20 degrees.

Mean temperature of the winter months, 34.88 deg., which is 5.17 deg. above the average winter temperature; of the spring, 56.63 deg., which is 0.33 below the average; of the summer, 74.92 deg., which is 1.60 deg. below the average; of the autumn, 49.56 deg., which is 3.58 deg. below the average.

The coldest month of the year was December, with mean temperature, 25.84 deg.; the coldest week was December 25th to 31st, with mean temperature, 9.41 deg.; the coldest day was December 28th, with mean temperature 2.7 degrees below zero. The mercury fell below zero only twice during the year, on December 28th and 29th.

The warmest month was July, with mean temperature 75.75 deg.; the warmest week was August 13th to 19th, with mean temperature 82.61 deg.; the warmest day was August 18th, with mean temperature 86 deg. The mercury reached or exceeded 90 deg. on 41 days, viz.: 1 in April; 7 in May; 8 in June; 13 in July; and 12 in August.

The last light frost of spring was on April 30th; the first light frost of autumn was on September 13th, giving an interval of 136 days (nearly 5 months), entirely without frost. The last severe frost of spring was on March 20th; the first severe frost of autumn was on October 17th, giving an interval of 211 days (nearly 7 months), without severe frost. No frost or cold weather during the year did any damage to fruit buds or trees. Both large and small fruits were produced abundantly.

The entire amount of rain, including melted snow, was 32.65 inches, which is 3.34 inches below the average annual amount for the twelve preceding years. Either rain or snow fell on 89 days—12 less than the average. On 11 of these days the quantity was too small for measurement. The longest interval without rain during the growing season (March 1st to October 1st) was 18 days—from August 2d to 19th. The number of thunder showers was 29. There were 4 light hail storms, all of which occurred in March, April and May.

The entire depth of snow was 7 inches, which is about one-third of the average. Of this amount 3 inches fell in March, 2½ inches in November, and 1½ inches in December. The last snow of spring was on March 15th; the first snow of autumn was on November 16th.

The average cloudiness of the year was 40.15 per cent., which is 4.18 per cent. below the average. The number of clear days (less than one-third cloudy) was 196; half clear days (from one-third to two-thirds cloudy), 87; cloudy (more than two-thirds), 83. There were 65 days on which the cloudiness averaged .8 or more. There were 51 entirely clear and 33 entirely cloudy days. The clearest month was February, with an average cloudiness of 24.94 per cent. The cloudiest month was December, with an average of 54.08 per cent. The mean cloudiness at 7 A. M. was 44.79 per cent.; at 2 P. M., 44.20 per cent.; at 9 P. M., 31.48 per cent.

During the year, three observations daily, the wind was from the sw. 324 times; nw., 242 times; se., 158 times; s., 113 times; ne., 107 times; e., 61 times; n., 55 times; w., 37 times; calm, *once*. The south winds (including southwest, south and southeast) outnumbered the north winds (including northwest, north and northeast), in the ratio of 595 to 404.

The number of miles traveled by the wind during the year was 146,039, which is 9,154 miles above the annual average for the 7 preceding years. This gives a mean daily velocity of 389.01 miles, and a mean hourly velocity of 16.62 miles. The highest velocity was at the rate of 80 miles an hour, from 3:30 to 3:45 A. M., on April 25th. The highest daily velocity was 1,121 miles, on March 27th and April 18th; the highest monthly velocity was 16,709 miles, in April. The three windiest months were March, April and May; the three calmest months were July, August and September. The average hourly velocity at 7 A. M. was 15.30 miles; at 2 P. M., 18.44 miles; at 9 P. M., 15.70 miles.

Mean height of barometer column, 29.123 inches; at 7 A. M., 29.148 in.; at 2 P. M., 29.099 in.; at 9 P. M., 29.123 in.; maximum, 29.791 in., on November 21st; minimum, 28.303 in., on April 18th; yearly range, 1.488 inches. The highest monthly mean was 29.295 in., in November; the lowest was 29.019 in., in May. The barometer observations are corrected for temperature and instrumental error.

The average atmospheric humidity for the year was 67.9; at 7 A. M., 79.2; at 2 P. M., 49.9; at 9 P. M., 74.6. The dampest month was December—mean humidity, 76.5; the dryest month was April—mean humidity, 53.4. There were 18 fogs, of which 9 were in January and 4 in December. The lowest humidity for any single observation was 11.8, at 2 P. M. on April 14th—less than one-eighth of saturation.

The following tables give the mean temperature, the extremes of temperature, the velocity of the wind, the per cent. of cloudiness, the relative humidity, the rainfall (including melted snow), and the depth of snow for each month of the year 1880, and a comparison with the 12 preceding years:

1880.	Mean Temp'ture.	Maximum Temp'ture.	Minimum Temp'ture	Miles of Wind.	Mean. Cloudiness.	Relative Humidity.	Rain inches.	Snow inches.
January....	41.23	67.0	20.5	12,861	48.49	73.8	1.80	0.0
February..	37.58	69.0	8.0	11,861	24.94	64.5	0.73	0.0
March......	42.38	79.0	2.5	13,841	44.94	63.4	2.03	3.0
April.......	56.92	93.0	31.0	16,709	34.56	53.4	1.75	0.0
May........	70.59	94.0	52.0	14,108	40.43	62.6	4.11	0.0
June........	73.57	96.0	50.5	12,629	37.00	68.1	4.10	0.0
July..	75.75	98.0	54.0	9,312	28.23	68.3	2.34	0.0
August.....	75.45	101.0	50.5	8,863	45.70	70.8	7.93	0.0
September.	64.59	85.0	42.0	10,124	32.00	73.2	2.46	0.0
October....	52.52	81.0	28.0	12,745	39.24	66.3	2.73	0.0
November.	31.58	65.5	7.5	11,325	51.77	74.4	2.24	2.5
December.	25.84	61.0	−12.0	11,661	54.08	76.6	0.43	1.5
Means......	54.01	82.5	27.9	12,169	40.15	67.9	2.72	0.6

COMPARISON WITH PREVIOUS YEARS:

YEAR.	Mean Temp'ture.	Maximum Temp'ture.	Minimum Temp'ture.	Miles of Wind.	Mean Cloudiness.	Relative Humidity	Rain inches.	Snow inches.	Rainy days.
1868	53.36	101.0	*-16.5	....	42.35	....	37.42	27.50	77
1869	50.99	96.0	- 5.0	....	49.23	....	38.51	18.00	105
1870	54.50	102.0	-10.0	....	47.88	68.4	31.38	9.50	100
1871	54.30	103.0	- 6.0	....	47.37	....	33.23	29.75	120
1872	51.90	97.0	-18.0	....	44.33	64.4	32.63	23.25	116
1873	52.71	104.0	-26.0	154,508	42.46	64.0	32.94	26.50	101
1874	54.20	108.0	- 3.0	145,865	45.54	65.5	28.87	43.00	99
1875	50.60	99.0	-16.5	145,316	44.81	65.5	28.87	5.00	106
1876	52.76	98.0	- 5.0	148,120	41.27	66.8	44.18	24.75	102
1877	54.16	99.0	- 9.0	113,967	47.12	72.6	41.09	15.50	126
1878	55.33	98.0	- 6.0	125,793	40.65	70.4	38.39	25.50	107
1879	54.67	99.5	-16.0	124,768	40.01	67.1	32.68	10.35	90
1880	54.01	101.0	-12.0	146,039	40.15	67.9	32.65	7.00	89
Mean 13 yrs	53.34	100.4	-13.0	138,047	41.09	67.2	34.83	20.43	103

METEOROLOGICAL OBSERVATIONS AT WASHBURN COLLEGE, TOPEKA, KANSAS.

PROF. J. T. LOVEWELL.

Our last report closed December 20th. From the 27th to end of month the weather was very cold, the mean daily temperature on the 27th, 28th and 29th being respectively, -3.3°, -6.2° and -3.2°. The minimum thermometer on the 29th recorded 21½ degrees below zero. This cold period has extended into January and the temperature has fallen below zero on five days—the 3rd, 9th, 10th, 13th and 14th. On the 9th it was 15° below zero. The last decade has been somewhat warmer than the two previous, as will be seen by the tables below. There has been but little snow, not enough for sleighing any time, but on more than half the days embraced in this report the cloudiness has averaged eight-tenths and more. Lunar halos and parhelia have been frequent. The prevalence of north winds has been noticeable, nearly two-thirds of the observations being north and north-west. The air has been moist and the evaporation therefore light, which lessens the danger to crops from the continued absence of rain. The barometric pressure has been high as is usual here when north winds prevail, and the fluctuations of pressure have been less than usual.

*The Minus sign denotes temperature below zero.

RECORDS DEDUCED FROM AVERAGES OF DAILY OBSERVATIONS.

	Dec. 20th to Jan. 1st.	Jan. 1st to 10th.	Jan. 10th to 20th.	Mean.
TEMPERATURE.				
Min.	3.6	0.8	9.4	4.6
Max.	19.7	24 5	30.8	25.0
Mean of Max and Min.	11.6	12.7	20.4	14.9
Range.	15 1	23.7	21.4	20.1
7 a. m.	6.6	4 8	14.5	8.6
2 p. m.	17.3	13.7	23.9	20.0
9 p. m.	11.1	11.9	19.0	14 0
Mean	11.5	11.8	19.1	14.1
REL. HUMIDITY.				
7 a. m.	0.77	......	......	......
2 p. m.	0 74	......	......	......
9 p. m.	0.77	......	......	......
Mean	0.76	......	......	......
PRESSURE, sea-level, 32° F.				
7 a. m.	30.4	30.2	30.1	30.2
2 p. m.	30.3	30.2	30.1	30.2
9 p. m.	30 3	30.2	30.1	30.2
Mean	30.3	30.2	30.1	30.2
WIND.				
Miles Traveled	3,014	2,824	3,490	9,328
RAINFALL.				
Inches	0.03	0.01	0.06	1.00

SOLAR HALOS.

BY PROF. S. A. MAXWELL.

On the 29th of last month, at eight o'clock in the morning, a most beautiful solar halo was observed from this locality. The mercury at the time indicated —12°, and the air was filled with particles of frost. The halo consisted of: First, a circle, 45 degrees in diameter, of white light, the sun being in the center; second, another circle of white light, parallel with the horizon, at the same altitude as the sun, and at right angles to the first circle; third, an iridescent arc of perhaps 90 degrees, belonging to a circle of 45 degrees diameter, and having the zenith for its center; fourth, a vertical column of white light, with the sun for its base.

The points of intersection of the first and second circles were adorned with two splendid parhelia of prismatic colors. The colors in the arc near the zenith were arranged as in the primary rainbow, the red being on the outer, or convex side.

A similar halo occurred on the morning of March 16th, 1870, when the temperature was 12° above zero; though, in this case the zenith circle was complete, but not prismatic, and the second circle was adorned at the cardinal points by mock-suns of surpassing brilliancy.

MORRISON, Ill., Jan. 10th, 1881.

PARHELION IN KANSAS CITY.

BY WM. H. R. LYKINS.

A phenomenon of rare occurrence in this latitude was observed in this city on the morning of the 7th of January. Just before sunrise a well defined image of the sun, apparently about fifteen minutes high, appeared shining at the intersection of two broad bands of light crossing each other at right angles. As the sun rose the image brightened until the brilliant spectacle was presented of two suns shining together in the eastern horizon. Gradually the true sun seemed to eclipse its double, and when the obscuration was complete the splendid pageant had vanished. Had the sun been higher in the heavens we should doubtless have had a fine display of parhelia, or mock suns, in which the sun is surrounded by circles and arcs of circles, and two, three, five or seven images are seen where the bands touch the coronæ.

Parhelia are very common in high latitudes and have been described by all Arctic travelers. They have also been mentioned by Aristotle, Pliny and other ancient writers. Pliny, not to be outdone, says that stars have been seen surrounding the sun at mid-day. Parasalenæ, or images of the moon, are also seen under similar circumstances as the parhelia, and are doubtless produced by the same causes.

BOOK NOTICES.

BURR'S LIBRARY INDEX. Quarto, pp. 320. Half Russia. J. B. Burr Publishing Co., Hartford, Conn. $3.50.

When attending college, some twenty-five years since, we deemed Todd's Index Rerum an invaluable aid in recording and classifying items of various kinds picked up in our reading. Since that day we have adopted several plans of our own for preserving for subsequent reference such matters of historical, political and editorial value as we considered might be found useful in our work. Many an hour of tedious searching has been saved by this, and many a tedious hour has been spent by us in searching for some article or passage which would have been found in five minutes if we had taken the pains at the proper time to enter its page and volume in our Index.

The Burr Publishing Company has brought out a "Library Index" which is far superior to anything of the kind we have ever seen, and which will be found of the greatest value to ministers, teachers, editors, authors and all others who cannot store up in their memories all that they read and who are compelled frequently to look up facts for comparison and generalization in their respective vocations. We have been accustomed in our editorial work to keep memoranda of valuable and important articles found in our exchanges in a blank book with an ordinary index cut in the side. We have also adopted the plan of cutting out and preserving within easy reach the printed indexes of such exchanges, so that when we desired to cram for a certain subject we could look up all that had been published in any of them without much trouble. But it will be seen that either of these plans is troublesome and unsatisfactory, while the use of Burr's publication, with its double and treble indexes, saves a great part of the labor and gives just what is needed, in a classified and condensed form, and preserves it in a handsome volume, easy to handle and an ornament to any book-shelf or library table. A very good description of this work is further given in our advertising columns.

THE PROBLEM OF HUMAN LIFE. By A. Wilford Hall: Octavo, pp. 524. Hall & Co., New York, 1880. $2.00.

This work is offered as an explanation of the quality and operation of the life principle on the basis of its assumed necessary substantiality, as an annihilation of evolution, and as a destructive review of Darwin, Huxley, Tyndall, Haeckel, Helmholtz and Mayer. Several chapters are devoted to a consideration of matter, substance, force, life, mind, soul, spirit, God. The fifth and sixth, constituting more than one-third of the volume, to that of the Nature of Sound, and the remainder to Evolution.

The author writes succinctly and forcibly, and carries with him a kind of magnetism which attracts the reader if it does not convince him. His introduction contains the gist of his argument against a "theistic evolution," and it must be admitted that he meets those portions which he quotes of the statements of such writers as Dr. McCosh, Rev. Joseph Cook, etc., fairly and with great appositeness; charging that this view of evolution is the same as Darwinism, except that Darwin takes no account of God after the miraculous creation of the first simple form, while the theistic evolutionists claim that every variation of one species into another is produced and nurtured under the supervising direction of God's providence. He is aggressive in his manner, and ridicules Joseph Cook's physiological statements unsparingly, and at the same time sarcastically terms it "obsequious absurdity" in Dr. McCosh to admit that there is nothing antagonistic between spontaneous generation and a religious belief in the existence of God.

To give the reader a better idea of his theory of the forces that exist in man and nature analogous to those exerted by God himself and that possess a substantial, or, as he expresses it, an entitative nature, as opposed to an ethereal or impalpable form, we quote a brief passage from the first chapter: "And whenever we can grasp the thought that man is a dual being, possessing a double organism, the one structure being corporeal, visible, tangible, the other incorporeal, invisible, and intangible; and when we can further recognise the fact that man, through the aid of his senses, can really and truly extend his personal presence to a limited distance beyond that of his corporeal form, we can then conceive of an infinite personality who may exist upon his throne in one part of the Universe, and whose all-pervading substantial or entitative attributes, analogous to our senses, but infinitely surpassing them, may make Him literally omnipresent, causing his actual being to extend through all extent."

This quotation gives, as well as any single passage can, a condensed statement of the author's theory of the Problem of Life, its origin, sustaining principle and connection with the future life; yet he denies that it is in any sense materialistic.

The chapters on the Nature of Sound were reviewed in these pages last year, and we find no reason to change our views then expressed, which were, in brief, that the experiments of the most learned, patient, pains-taking, catholic investigators of the world, repeated in every imaginable form and manner, and corroborated in each instance, are not to be given up until after they have been met and controverted by equally careful and successful experiments based upon other hypotheses, which has not been done so far. Our author may succeed in overturning evolution, but we do not think he has applied his lever at the right point this time. The book has its crudities and errors of logic, as all theoretic works are liable to have, but it has its corresponding attractions and will prove deeply interesting to popular readers of all classes.

JOHN SWINTON'S TRAVELS: By John Swinton. G. W. Carleton & Co., N. Y.; 12 mo., pp. 46, paper; 25c.

This little volume consists of "current views and notes of forty days in France and England," in August and September, 1880 The author states in his preface that his reasons for publishing them will be found by those who properly read them; but after reading the book with some care, if he had any other object in view than to glorify the civilization and republican institutions of France to the disparagement of his own country, we have failed to "read properly."

THE EDEN TABLEAU: By Charles Beecher. 12mo. pp. 163. Lea & Shepard, Boston, 1880; cloth, $1.50.

In this work we find what the author terms "an attempt at a more thorough and consistent application of the laws of analogic interpretation to one of the most interesting and vital portions of the Bible," referring to the Mosaic legend of Paradise. In his preface Mr. Beecher favors his readers with a concise but comprehensive review of the various ethnic religions, including those of the Chinese, Japanese, Brahmins, Persians and Egyptians, in all of which he points out the idea of the spiritual origin of all things—the priority of the spiritual world over the material. In metempsychosis, which was the belief of the majority of mankind and from which sprang all religions, he finds but a corruption of the primitive doctrine of a celestial pre-existence, which was the original faith of Israel, and which was bequeathed to the early Christians.

Discussing the priority of religions, he urges that faith in a primeval paradise, either terrestrial or celestial, or both, has been the universal heritage of man, recording itself not merely in uncial manuscripts, but in letters of stone and earth, big as pyramids and mountains, and perpetuated in arbitrary emblems and rites and sacrificial ceremonies, from age to age, among peoples the widest apart in locality, lineage and language; claiming, finally, that of all paradisaic legends, that of Moses is simplest, purest, most in accordance with good taste and most readily yields a consistent and lofty spiritual meaning under the application of the simple laws of analogy. It must be, therefore, presumptively the true one and studied with reverence as throwing light upon the mysterious question of the past history of the spiritual universe.

In the body of the book are taken up and analyzed successively the Garden of Eden as an emblematic whole, the Tree of Life, the Tree of Knowledge, the First Adam, the Second Adam, the Serpent, the Attack, the Examination, the Sentence on the Serpent, the Sentence on Man and Woman, etc.; closing with the Eden Tabernacle, the Cherubim, the Four Rivers, Comparative Theology. It is a remarkably suggestive book and will be a world of consolation to doubting Christians and a source of gratification and pleasure to all scholarly readers.

The Religion of Ancient Egypt. By P. Le Page Renouf: 12mo. pp. 270: Scribner's Sons, New York, 1880. $1.50.

This work is made up of the Hibbert series of lectures for 1879, and is an account of the origin and growth of religion, as illustrated by the religion of ancient Egypt. The six lectures are on the following topics, viz: "The Sources of Information respecting the Ancient Egyptian Religion," "The Antiquity and Characteristics of Egyptian Civilization," "The Gods of Egypt," "Communion with the Unseen World," "The Religious Books of Egypt," "Henotheism, Pantheism and Materialism;" and no one can read them without being convinced that their distinguished author has given a vast amount of personal observation and study to the subject and has drawn conclusions that must be acceptable to the majority of thinkers.

Beginning with the ancient heathen writers, he traces the religious beliefs of the Egyptians, through the hieroglyphic writings as deciphered and translated by Champollion and his successors, the monuments of the Rameses, the tablets of Abydos and Saqâra, the transcriptions of Manetho, and the moral code of Ameni.

The conclusion seems to be that the religion of Egypt was not from the first the mere worship of brutes which strangers imagined it to be from its practices in the days of its decline; the worship of animals being a consequence only and not a foundation principle. The elements of it were a sense of the infinite and eternal, holy and good, governing the world, and upon which we are dependent —of right and wrong, holiness and virtue, immortality and retribution.

The author fails to find the impress of Egyptian influences upon Hebrew institutions, or that any of the idolatries or superstitions of the Israelites were derived from Egyptian sources, and sustains his position on this point ably. The book will be found most interesting and instructive to the best scholars as well as to merely popular readers.

OTHER PUBLICATIONS RECEIVED.

Laboratory Notes from the University of Cincinnati, by Prof. F. W. Clarke and some of the members of his classes.—Studies of the Food of Birds, Insects and Fishes, made at the Illinois State Laboratory of Natural History, at Normal, Ill., by S. A. Forbes, Director.—History of the Leavenworth *Times*, by D. R. Anthony, proprietor.—Indications of Character in the Head and Face. Illustrated. By H. S. Drayton, A. M. Fowler & Wells, publishers, New York. 15c.—Catalogue of the Officers and Students of Marietta College, Ohio, 1880–81. —Seventh Annual Report of the Board of Control of the State Public Schools for Dependent Children, 1880: by Lyman P. Alden, Superintendent.—Circular of the State School of Mines, Golden, Colorado, 1880–81.—Hamilton College, Sixty-ninth Annual Catalogue of Officers and Students, 1880–81, from Prof. Oren Root, Jr., Ass't Professor of Mathematics.

SCIENTIFIC MISCELLANY.

KANSAS SCIENTIFIC SURVEY.

PROF. J. D. PARKER, KANSAS CITY, MO.

The Kansas Academy of Science, at their November meeting, appointed a Commission to memorialize the Legislature in reference to a State Scientific Survey. Two preliminary surveys under Profs. Mudge and Swallow have already been made. A considerable amount of work has also been done, under the auspices of the Academy of Science, whose results need to be gathered up and put in permanent form. The Academy of Science has nearly completed a determination of the plants of the State, a large amount of the work having been prosecuted by that veteran botanist, Prof. Carruth, without any remuneration. In the proposed survey would it not be most fitting to place the necessary means in the hands of Prof. Carruth to complete his determination of the flora of Kansas and prepare a herbarium of the plants of the State, as complete as may be possible, to be placed in the Capitol building? This work would form the crown of a life devoted with singular disinterestedness to scientific pursuits, and Kansas would honor a citizen worthy of being remembered. A complete herbarium of the plants of the State placed in the Capitol, would be a treasure which few States possess.

Prof. Mudge accomplished before his death a large amount of geological work for Kansas. The Mudge Cabinet, bestowed with princely liberality upon the Agricultural College was a monument worthy of any geologist. All his papers read before the Academy were based upon original observation and research and were real and substantial contributions to science. Prof. Snow is many-sided, and has contributed to our scientific knowledge in several departments. His contributions to botany are valuable; he has given us a nearly complete catalogue of the birds of Kansas; he has made large determinations among the insects; he has determined the species of fish in the Kansas river at Lawrence, and has kept a meteorological journal covering many years, which is recognized and referred to by meteorologists everywhere. Prof. Popenoe has been a valuable co-laborer in entomology and his labors are full of promise. The Government has placed a full set of self-registering meteorological instruments under the charge of Prof. Lovewell, of Topeka, who is now keeping a valuable weather journal.

Prof. O. St. John has, during his leisure time, extending over two years, completed a stratigraphical survey of the geological formations from the mouth of the Kansas river to Manhattan. This work has been accomplished with all the accuracy and perfection characteristic of the United States survey, of which Prof. St. John has been the palæontologist. Prof. St. John was with Prof. Agassiz in his expedition to South America, and has had a wide and varied experience in scientific pursuits. Kansas would be fortunate indeed to secure his services as Director of the proposed scientific survey. Prof. Bardwell did something in the way of triangulation, and by his death science lost a most valuable worker. Prof. Kedzie before his death, and Prof. Patrick have both done something in the way of determination of soils and minerals. There have been other laborers in various departments, valuable auxiliaries in the prosecution of the work, whose services have been cheerfully rendered without reward. Aside from the two preliminary surveys, all of this work has been accomplished for Kansas without asking a dollar from the State, except in the bare publication of the results. If there ever was a society that has been abundant in labors, extending over more than a decade of years, whose services have been rendered "without money and without price," it is the Kansas Academy of Science. In view of all those disinterested services in the cause of science, an appeal from the Academy for the State to gather up these results, and carry forward the survey, will surely not be unheeded.

There are cogent reasons why Kansas should resume the State Scientific Survey at the present session of the Legislature. Should the survey be put off two years, until the next biennial session of the Legislature, it would seem almost like a calamity. Nothing would more powerfully attract immigration than to ascertain and make known the vast natural resources of the State. A thorough scientific survey appeals to and attracts the more intelligent classes so desirable in any State. Kansas has been a leader in many things, and she cannot afford to lose her prestige. In our civil war the fires of liberty burned the brightest on Kansas soil. She has a double land grant for educational purposes, and the school fund, when all the lands are sold, will probably aggregate ten millions of dollars. She has passed a law creating institutes for the normal training of teachers in *every* county—a feature already yielding good results, which has attracted the attention of educators from other States. She is the first of all the states to put prohibition in the state constitution, making temperance the organic law of the land. Kansas cannot afford to lose her leadership among the states in the onward progress of ideas. New York has spent half a million dollars on her scientific survey, and has become known as classic ground throughout the scientific world. The thorough development of the coal fields of Kansas would pay the State the entire cost of a geological survey many times. There are vast deposits of lead and zinc in the southeastern part of the State which need to be explored thoroughly. No other State has such wonderful beds of gypsum as Kansas which occur in those portions of the State where it is needed. The strata lie like the leaves of a book laid on its side which is shaved off from its upper northwest corner to its under southeast corner. Over the edges of these out-cropping rocks pour the rivers of the State with rapid flow in an eastern or south-eastern direction. Here is a vast system of rivers whose capacity for hydraulic power is almost unlimited, and yet no engineering skill has revealed the latent forces which nature designed to be employed by man. With immense cotton fields on the South, mountains of iron on the Southeast, and unlimited deposits of precious ores on the West, with thousands of square miles of coal and an almost unlimited hydraulic power from rapidly flowing rivers, it would be a shame for Kansas very much longer to import her cotton fabrics from New England, much of her railroad iron from Pennsylvania, and her agricultural implements from other more enterprising communities. Several counties in the western portion of the State would be benefited vastly by a system of irrigation which a State survey could easily devise. The comparative excellence of the immense beds of lime-stone and freestone should be accurately determined. A careful analysis of soils in various portions of the State would not be without its benefits to the farmer. Kansas is a paradise for scientific explorers and she cannot afford to wait and let her finest fossils be carried off to enrich the cabinets of eastern institutions of learning. The bare freight on vertebrates alone sent to Yale College from Kansas and Colorado has amounted to as much as a thousand dollars a year. There is considerable probability that artesian wells would flow from the eastern dipping strata in the western portion of the State, where they are so much needed. Our knowledge of the rainfall of the State needs to be based on wider observations.

If a proper proportion of Kansas were planted in forests, which the fostering hand of the State can accomplish, she would be for agricultural purposes the best, and soon the richest State in the Union. Her three greatest enemies would be subdued which now triumph over her more or less one after another from year to year. The State would not be subject to drouth, the grasshopper would cease to be a burden, and destructive winds would be driven into the upper regions of the atmosphere, and thus, as in all forest countries, pass over the State. The power of the terrible tornado would also be broken. A scientific survey for Kansas, possessing a wider scope than ordinary geological surveys, should determine the kind of trees best adapted to different portions of the State.

Kansas has the greatest possibilities for good and liabilities for evil. The first can only be developed, and the latter averted by a knowledge of her resources and capacities resulting from a thorough scientific exploration. Such a survey would pay in a thousand ways. In prosecuting her geological survey, Michigan discovered her immense deposits of salt, which yield a revenue to the State annually of half a million dollars. And yet Illinois prosecuted her geological survey at an expense only of five thousand dollars a year, as such a survey calls forth almost an equal additional amount from benevolently disposed individuals and from the courtesies of railroad companies. Kansas cannot delay any longer her geological survey without great injury to the State. Nothing could grace the new wing of the Capitol building so well as a full collection representing the minerals and rocks, the fossils, animals and plants, of the State. Such a collection would present an irresistible attraction, and afford the materials for a thorough knowledge of the resources of the State which Kansas does not now possess.

IMPROVEMENT OF THE MISSOURI RIVER AT KANSAS CITY, MO., 1880.

The imperative necessity of checking the erosive action of the river in the bend above the city of Wyandotte, which so seriously threatened the safety of the Kansas City bridge and the levee front of this city, was brought to the notice of the government engineers in the fall of 1878. The Representative from this district placed the matter before Congress, which appropriated thirty thousand dollars for works of improvement designed to prevent the river from leaving Kansas City, with its bridge, inland. The appropriation became available in April, 1879, and work was immediately begun, in accordance with a plan laid out by Major C. R. Sutes, Corps of Engineers, U. S. A. The amount given being less than one-third what was asked to complete the work, and which it was contemplated should be expended in one year, it became necessary that the money be expended in constructing works of protection, leaving those of control to be completed at some future time.

The work done consisted in the construction of a "weed dyke," 650 feet long, and a continuous brush mattress, 5,042 feet long and 92 feet wide, with a thickness of about 6 inches—both devices being modifications, or improvements of such as had been used successfully in the rivers of India. These were built on the left bank above Wyandotte. The first was designed to deflect the course of the river, while the last, being laid along the bank, was intended to prevent further cutting. With their completion the appropriation was expended, and work suspended.

The immediate effect was all that could be desired; a very considerable shifting of the channel was secured, the erosion checked, and the threatened "cut off" prevented.

During the next session Congress made a second appropriation of twenty-five thousand dollars for the continuance of the work in accordance with the original plan, which sum has not yet been expended.

With the opening of the river in the spring, active operations will be resumed. The general plan under which the work is to be done contemplates shore protection, and the development of new shore lines from Quindaro to Wyandotte, by the building up of bars and the straightening of the river on the crossings. Lengthening, rather than shortening of the river is designed, while the stream is to be kept within its present shore lines.

Attempts by corporations to control the Missouri river and improve it have been heretofore abortive, giving rise to the popular notion that the stream is beyond control, but the work done by the government during the past two years shows conclusively that the river can be improved, that permanent shore lines can be secured and a permanent channel maintained, and this at a trifling cost, when its importance is considered.

The United States engineer now stationed here, Mr. J. W. Nier, in pursuance of orders received by him from the Government, will at once proceed to construct two scows to be used in the Missouri river improvement, in the bend above Wyandotte, the coming season. The boats are to be about 100 feet in length and 22 feet wide, and will be built at the Wyandotte levee. The machinery for the boats is now on the way. Each craft will be outfitted with a large boiler thirty feet in length, weighing sixteen and a half tons, a compound Worthington duplex grading pump, a pair of shears and a steam capstan.

The Worthington pumps have been used with success at Omaha and other places. With an ordinary head of steam 750 gallons of water are discharged per minute. This stream thrown against a bank will remove more earth in a given time than 200 laborers. Last year, on account of the scarcity of labor and the refusal of men to work at the prices paid, work on the river improvements was for a time suspended. By means of the new appliances the engineers will be rendered comparatively independent. The cost of grading will also be greatly lessened.

It is expected that the boats will be completed within three months, and that the work done in 1881 will not only be preventive, but fully and permanently protective.

THE ALMACANTAR.

S. C. CHANDLER, JR.

I desire to call the attention of practical astronomers to a new instrument for the determination of time and latitude, the principles of the construction of which are, I believe, novel, and which seems to possess advantages entitling it to consideration. From the results attained with an experimental instrument, which has been very neatly constructed for me by John Clacey, of this city, I feel justified in claiming that in accuracy, efficiency and convenience, this construction, for moderate-sized instruments, is superior to the transit instrument, while it is very much cheaper. The principle involved is the same as that of Kater's floating collimator for determining the zenith point of a graduated circle. Beyond this, however, there is no resemblance.

The following brief description of the instrument may be easily understood, by reference to the illustration. It consists of a heavy base, with approximate leveling screws at the corners, from the center of which arises an upright cylindrical pillar surmounted by a cap of hard brass, and encircled at the middle and base by brass collars. These serve as the bearings for a hollow, brass sleeve, fitting closely to the pillar and turning smoothly upon it. This sleeve is provided with a cross-head and lateral, diagonal braces which support a shallow trough in the form of a hollow rectangle. In this trough is contained mercury to the depth of about one-eighth of an inch, upon which swims a float of wood or iron, also in the form of a hollow rectangle, a little smaller than the trough. By means of two pins, projecting from the sides of the trough and playing in vertical slots in the sides of the float, the latter is kept in place, while it is free to seek its equilibrium. From the middle of the inside edges of the float project two bent arms of brass, the lower ends of which support the horizontal axis of the telescope. The axis is provided at one end with a clamp, and at the other end with an illuminating contrivance, and the telescope has a reticule of five horizontal spider lines.

If the telescope is turned on its axis and clamped at any desired altitude, and the whole instrument revolved around the upright axis, the sight line will describe a small circle in the heavens, parallel to the horizon. It is evident that the transit of stars, as they rise or fall over this horizontal circle, may be observed, and will furnish the means of finding the clock error, and also the latitude by a proper selection of the stars in different azimuths.—*Science Observer.*

KANSAS UNIVERSITY SCIENTIFIC NOTES.

Last summer, Prof. Snow, in company with Mr. L. L. Dyche and Miss Anna Mozley, spent four or five weeks in Santa Fe cañon, N. M., collecting beetles, moths and plants. It was in a country that had never been explored with a similar purpose, and a rich harvest was obtained. Several thousand specimens were brought home. Of those only the *Coleoptera* have been examined and twelve new species have been found. Of one of these Dr. LeConte, late president of the American Academy for the Advancement of Science, writes, that it is "the most extraordinary addition to our fauna that has been made for a long time," and the Doctor is usually sparing of adjectives. Speaking of the Colorado expedition two years ago, Prof. A. R. Grote says: "Such labors have a permanent value in the field of Natural History in America and their continuance is greatly to be hoped for in the interest of science." In addition to this both LeConte and Horn have described several of the new species for the Kansas Academy of Science, an honor never before granted to Kansas.

The University does well to encourage scientific research, and the State should feel proud of the men who are bringing Kansas to the front in the realm of science. Professors B. F. Mudge, F. H. Snow and G. E. Patrick are prominent in the company. Prof. Mudge has ceased his labors, but the others are carrying the work on with enthusiasm that has and will merit success.—*Lawrence Journal.*

EDITORIAL NOTES.

SINCE the last regular meeting of the Kansas City Academy of Science our citizens have had the rare pleasure of a lecture by the well known artist, Col. James Fairman, of Chicago, upon the "Study of Fine Art." It was an eloquent, discriminative and classical effort—one of the most instructive and entertaining lectures yet offered our people under the auspices of the Academy. It is hoped that Col. Fairman may return here and deliver his full course.

THE Historical Society of New Mexico, which was organized in 1857 and flourished until the commencement of the war of 1861, when it died out on account of the dispersion of its members, has lately been revived and reorganized, with acting Governor W. G. Ritch for President; Judge L. B. Prince, Vice-President; David J. Miller, Corresponding Secretary; Wm. M. Berger, Recording Secretary; Lehman Spiegelberg, Treasurer, and J. C. Pearce, Curator.

Mr. Miller informs us that "while dormant its excellent and valuable collection of Spanish, Mexican and Indian relics, curiosities and remarkable natural productions of New Mexico disappeared irrecoverably. There is a fine field (he says) open to us yet, however, and I am sure the reorganization will duly utilize it in the acquisition and preservation of interesting and valuable information within and concerning historic old New Mexico."

FROM the report of the annual meeting of the Davenport Academy of Science, held Jan. 5, 1881, we learn that this best known of Western institutions has been in operation for thirteen years, owns its building, has about 4,000 volumes in its library, thousands of mound relics in its cabinets, comprising inscribed tablets, tools of copper, flint implements, etc., etc., besides geological and mineralogical specimens in great abundance. Its principal officers and J. Duncan Putnam, President; Dr. C. C. Parry, Corresponding Secretary, and C. E. Putnam, Treasurer.

PROF. F. E. NIPHER, the distinguished physicist of Washington University, St. Louis, has sent us his beautiful photographic map of Equal Magnetic Declinations, prepared from the numerous and laborious magnetic surveys made by him during the past three years. It is a wonderful example of patient and skilled scientific labor on his part, and the results will undoubtedly be a great surprise to all who examine it.

At the St. Louis Academy of Science, on the 19th ult., Prof. Nipher displayed a plaster cast of a *raised* map of the State of Missouri, showing the magnetic lines in *bas relief* on a scale of twenty miles to the inch in the area of the State. This, he informs us by private letter, it is his intention to have photographed, or artotyped, and sent to various portions of the State for sale.

They will be found very interesting to all and very valuable to many of our citizens, and we bespeak for him a liberal patronage. Though Prof. Nipher has made these surveys at his own personal expense so far, it is believed that by proper effort on the part of intelligent citizens of the State the Legislature may be induced to make the necessary appropriation to finish this important work, which will require about three years longer.

WE learn from the Catalogue of officers and students of Washburn College, Topeka, Kansas, for 1880-1, that there are 132 students of all grades, that the faculty is fully and comprehensively organized, that the curriculum of study is arranged with a view to a broad and liberal culture, in aid of which there is a choice library, a well equipped laboratory and cabinets of minerals, an assaying department, and very complete outfit of meteorological instruments. The college is not conducted in the interest of any religious denomination, but has for its object the promotion of the highest and best culture—mental, moral, social and religious.

WE are indebted to Mr. E. E. Richardson, assistant Secretary, for a copy of the tenth annual live stock report of the Kansas City Stock Yards, by which it appears that the increase in the number of cattle handled in the ten years is from about 121,000 to over 244,000; in hogs from about 41,000 to more than 676,000; in sheep from about 4,500 to nearly 51,000, and in horses from less than 900 to over 14,000.

WE present herewith a table showing the degree of cold here on the coldest day of each January since 1875:

	Jan.	7 A. M.	2 P. M.	10 P. M.
1875	9	−18°	9°	−5°
1876	10	11°	20°	20°
1877	16	−12°	5°	4°
1878	6	7°	18°	12°
1879	3	−14°	−5°	−7°
1880	30	23°	27°	25°
1881	9	−7°	4°	2°

THE Kansas City Electrical Society, recently organized, is a valuable acquisition to the list of scientific and social organizations of the city. The objects for which the society was formed are for the practical and the theoretical study of electricity, the examination and study of electrical apparatus and appliances. The following officers have been elected for the first year:

President, W. H. Woodring; Vice-President, T. F. Clohesey; Secretary, J. J. Burns; Treasurer, G. M. Myers; Executive Committee, Messrs. W. H. Woodring, J. J. Burns, Dr. Joshua Thorne, M. D. Wood and W. C. Stewart.

Capt. Howgate writes, Jan. 22d: "The outlook for the continuance of work in the direction of Lady Franklin Bay this year is quite encouraging. Dr. Rae writes me that there is a prospect of English arctic work via Franz Joseph Land, but it will not be done before 1882. All the European countries interested in Arctic matters are awaiting the result of our labors here. If we succeed, there will be no lack of foreign followers."

ITEMS FROM THE PERIODICALS.

It is wonderful how rapidly, though almost imperceptibly, a man who takes the leading periodicals of the country can build up a large and valuable library. Being crowded for space in our book shelves lately we were almost surprised to find so many volumes of *Harper's Monthly*, *North American Review* and *Atlantic*, all of which we have been receiving almost continuously for more than twenty-five years, except the latter, which has not been published quite so long. In these volumes can be found an epitome of all that has transpired in the literature, art, biography and science of the world during all that period, as well as reproductions of what has occurred in the past in these departments. A man in any avocation requiring constant reference to the labors of others, for instance an editor, could better afford to lose all the rest of his library than such volumes as these and a few other similarly comprehensive periodicals.

THE *Princeton Review* for January presents its usual massive array of original articles. That of Prof. William G. Sloan upon "The Public Schools of England," and of Dr. George P. Fisher, of Yale College, upon "The Historical Proofs of Christianity," being a consideration of the miracles of Christ, are the most attractive and readable in a popular sense, without the least disparagement of any of the others. This magazine is now in its fifty-seventh year, and is published in bi-monthly numbers of 148 pages at only $2 per annum.

HAVING arranged clubbing terms with the *North American Review*, we are enabled to offer that foremost of American periodicals, together with the KANSAS CITY REVIEW, at the low price of $6 per year. The *North American* is the organ of the best minds of America, nearly every writer of note in the country being a contributor to it. It discusses the subjects that are most prominent in the public thought at the time, and presents both sides of all important questions. It combines to a considerable extent the thoroughness of the Cyclopædia with the timeliness of the daily paper. It should be read by the professional man, the student, the merchant, the manufacturer, the farmer; in fact, by every one who wishes to form intelligent opinions on the events of the day.

NUMBER 17 of the *Humboldt Library* presents this month one of the best of Herbert Spencer's works "Progress"--one which every intelligent person can read with pleasure and profit, whether he adopts the peculiar views set forth or not.

The selections so far made by the editor of this popular series have been unusually judicious and well varied, having comprised geology, astronomy, metaphysics, education, natural history and physics. Six more numbers will be included in the first year, which, when bound together, will make a most valuable and comprehensive volume for the price.

THE *Phrenological Journal* of New York is the only periodical devoted to the subject, and it includes with this all that relates to Human Nature and the improvement of men physically, mentally and morally. In the prospectus of 1881 the publishers make liberal propositions to subscribers. The price has been reduced to two dollars a year, and to each subscriber is offered a new phrenological bust.

CAPT. F. M. POSEGATE, a prominent citizen and postmaster of St. Joseph, Missouri, recently delivered a lecture at Maryville upon the "Lights and Shadows of Life," of which the *Republican* of that place speaks in the highest terms as "a beautiful picture drawn with delicate fineness and a keen insight into human nature."

PROF. C. V. RILEY, who has been added recently to the editorial corps of the *American Naturalist*, writes that he has a few sets of the *Entomologist* to spare, which he will sell at $1,50 per volume, post-paid.

The Age of Steel, formerly the St. Louis *Journal of Commerce*, is one of the oldest commercial and manufacturing papers in the West, being now in its forty-ninth volume. It is also one of the best, and we have frequently availed ourselves of information derived from its columns in working up matter for the *Review*. It is published in St. Louis and furnished to subscribers at $3 for the weekly edition and $1 for the monthly edition.

WE have reeeived "Annual Reviews" from a number of sources, showing commendable enterprise on the part of editors of Western papers and wonderful growth in Western cities. Most prominent among these are the *Commercial Indicator* of Kansas City, the *Daily Bee* of Omaha, Nebraska, and the *Tribune*, published at Denver, Colorado.

Each of these papers is a marvel of good printing and laborious, accurate and valuable editorial work, creditable in every respect to its proprietor and certain to be of inestimable value to the city and district whose business growth and importance it publishes to the country.

Among other newspapers offering to club with the Review is the Boston *Journal of Commerce*, one of the very best commercial papers in the United States, a very large, handsome weekly, filled to overflowing with market reports from all over the world, mining news, the latest inventions and improvements in machinery, technology, etc., etc. The regular price is $3 per annum, but to any subscriber to the Review we can furnish it for $2.40, post-paid.

The article by our fellow-citizen, James Taylor, Esq., on "Our City Sewerage," in the *Journal* of Jan. 8th, was a plain, practical paper, full of excellent suggestions and worthy of the careful consideration of the City Council and of all property owners putting drain pipes into their houses.

It is conceded by the best medical authorities that disease is bred and fostered in an atmosphere poisoned by sewer gases, and we cannot be too careful to avoid them.

The Kansas City Review of Science and Industry

Enters upon its fifth year with the May issue, 1881, and is offered to the intelligent people of the country as an exponent of Western thought and a medium of communicating Western discoveries, inventions and theories.

64 PAGES, LARGE OCTAVO. $2.50 PER ANNUM: SINGLE NUMBERS 25c.

The Review numbers among its Contributors some of the most earnest and capable workers and thinkers in the West, as well as many Eastern scientists of prominence, and has been highly commended in all directions, for the freshness and originality of its articles and the promptness with which it publishes new discoveries and inventions.

CONTRIBUTORS WITHIN THE PAST YEAR:

Prof. G. C. Broadhead, late State Geologist of Mo.
Prof. G. C. Swallow, of the University of Missouri.
Prof. F. H. Snow, of the University of Kansas.
Prof. E. A. Popenoe, State Agricultural College, Kas.
Dr. F A. Ballard, Independence, Mo.
Rev. L. J. Templin, Hutchinson, Kansas.
Prof. E. L. Berthoud, Colorado School of Mines,
Prof. H. S. Pritchett, of the Morrison Observatory.
William Dawson, the Quaker Shoe-maker Astronomer.
Prof. A. J. Conant, St. Louis, Missouri.
Prof. T. B. Smith, Louisiana College, Mo.
Prof. F. W. Clarke, of the Cincinnati University.
Prof. F. E. Nipher, of the Washington University.
J. A. Smith, Paola, Kansas.
Mrs. M. W. Hudson, Topeka, Kas.
Prof. J. M. Long, Richmond, Mo.
Dr. Ivon D. Heath, Wyandotte, Kas.
Rev. T. L. Lewis, Bolivar, Mo.
Edgar L. Larkin, New Windsor, Ill.
Sam'l J. Wallace, Silver Cliff, Col,
Prof. E. T. Nelson, Ohio Wesleyan University.
A. L. Child, M. D., Plattsmouth, Neb.
Prof. Jno. B. Dunbar, Deposit, N. Y.
Prof. J. T. Lovewell, Washburn College.
Dr Chas. H. Sternberg, Ellsworth, Kas.
Prof. S. H. Trowbridge, Glasgow, Mo.
Prof. S. A. Maxwell, Morrison, Ill.

Hon. R. T. Van Horn,	Kansas City,	Mo.
Prof. John D. Parker,	"	"
Prof. George Halley, M. D.,	"	"
V. W. Coddington,	"	"
Robt. Gillham, C. E.,	"	"
W. W. Alexander,	"	"
Dr. W. A. Drowne,	"	"
Prof. E. C. Crosby,	"	"
Ermine Case, Jr.,	"	"
W. H. R. Lykins,	"	"
Dr. R. Wood Brown,	"	"
Dr. W. B. Sawyer.	"	"
John Fee, M. D.,	"	"
W. H. Miller.	"	"

Of Eastern Scientists who have, during the past year, contributed to the Review, we may mention Prof. H. C. Bolton, Trinity College, Hartford, Conn.; Prof. C. V. Riley, Washington, D. C.; Dr. S. W. Williston, New Haven, Conn.; Capt. H. W. Howgate, U. S. A.; Isaac P. Noyes, Rhode Island; Prof. O. T. Mason, Columbian College; Prof. John Rae, F. G. S:, London, England; M. F. Connor, Paris, France.

We have determined to continue the plan which proved so appropriate and acceptable last year, for giving premiums to our subscribers, viz.:

To any person who sends us $3.50 we will send the REVIEW for one year, and any $1.50 book published by D. Appleton & Co., S. C. Griggs & Co., Robert Clark & Co., Houghton, Miffiln & Co., Harper Bros., Roberts Brothers, J. B. Lippincott & Co., John Wiley & Sons, Henry C. Lea, S. R. Wells & Co., Ivison, Blakenan, Taylor & Co., Orange, Judd & Co., etc.

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As the fourth volume of the REVIEW will close soon, and we shall be asking our friends to renew their subscriptions, it may be well enough, by showing the estimation in which it is held by scientific men and periodicals in different parts of the country, to publish extracts from some of the encouraging letters and notices we have recently received. From them it will be observed that the REVIEW has met with favor not less in the East than in the West, and even in Europe it has found some readers of note who have been kind enough to express their appreciation of it and its management:

University of the State of Missouri, Columbia, Mo., May 13, 1879.

THEO. S. CASE, Esq.:

MY DEAR SIR: I can but congratulate you on the excellence of your journal, and I will try and aid you with an occasional article,

* * * * * * *

Yours truly,

G. C. SWALLOW.

Prof. O. T. Mason, Columbian College, D. C., the distinguished anthropologist, writes:

"I have frequently promised myself the pleasure of showing my appreciation of your very creditable journal by sending you something from the foreign field, &c."

Boston Scientific Society, January 31, 1879.

With thanks for kindness in sending your REVIEW to our Society, and congratulations upon the high standard it has reached, I am,

Ever yours,

J. RITCHIE, JR., Sec'y.

Osage City, Kansas.

I am much pleased with the articles in the number before me, and I deem it a better work for the general reader than most of the scientific journals of the present day.

Yours, &c., J. W. JACKSON.

New York, October 8, 1879.

I have offered to send the REVIEW to the library of the Metropolitan Museum of Art, of which Gen. L. P. di Cesnola is director, as its archæological papers will there be appreciated, and would like, therefore, a full set from the commencement.

Very sincerely,

DR. F. A. CASTLE.

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* * * The REVIEW is a very useful publication, and must contribute very sensibly to the material development of this section of the country, a record of whose history and development it is the object of the society to make up. Yours very truly,

F. G. ADAMS,
Sec. Kansas Hist. Society.

Washington, Jan. 20, 1879.

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I look upon your REVIEW as a very valuable addition to scientific journalism, and one especially interesting to the growing West.

Very truly yours,

H. W. HOWGATE, U. S. A.

PROFESSOR WILLIAM H. WAHL, of Philadelphia, associate editor of the *Engineering and Mining News*, published in New York City, writes, August 5th, as follows: "* * * * I take much pleasure in reading your REVIEW, and trust that you are succeeding with it."

There are several other articles by home and Western authors, which keep up the peculiarly distinctive character of the magazine as the organ of Western thought, while its miscellany is of the latest authority and choicest character. We grow more and more proud of our home publication.—*Kansas City Journal*.

KANSAS CITY

Review of Science and Industry,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. MARCH, 1881. NO. 11.

PHILOSOPHY.

THE SYNTHETIC PHILOSOPHY AN ORGANON OF THE SCIENCES.

BY PROF. J. M. LONG.

Philosophy, from whatever point of view it may begin its investigations, attempts the solution of the most difficult problem which can possibly engage the thought of the human mind. It attempts to construct a rational theory of the universe by the formulation of some all-embracing truth or principle which shall serve as the ground and explanation of all things as these appear in the bounds of space and in the evolutions of time. Of the deep interest which man must ever feel in the question of his relation to the universe, Schelling has truly said, "Would man strive to fathom this relation? I answer, if he would not, still he must. He always has striven after it; and, in the future, he always will strive after it."

The problem which philosophy attempts to solve is altogether of a different order from those which science deals. Science is satisfied when it can discover the nature of the phenomena belonging to a special province of nature, and can formulate the laws regulating their co-existences and sequences. Science analizes nature into parts, in order that man may attain a point of attack by which to gain control over her laws and forces. On the other hand, philosophy aims to reduce the thought-world to unity, which has been destroyed by the analytic processes of science. As the mind, in order to the harmony and completeness of thought, demands both analysis and synthesis, so we must have both science and philosophy. Philosophy justifies itself to science by showing that the methods and fundamental ideas of the latter are inadequate to their own explanation.

Hence, philosophy is defined by Hamilton as *the science of first principles*, and by Spencer as *completely unified knowledge*.

Having briefly stated the aim and scope of philosophy in general, we will be the better enabled to understand the special aims and scope of the Synthetic Philosophy as set forth by Herbert Spencer. In this system of philosophy we find exemplified the strongest intellectual tendencies of the age. If we would know what class of questions is stirring most deeply the minds of thoughtful persons; if we would know in what direction the thought of many of the leading minds of the age is traveling, then we must study the Synthetic Philosophy. It is not too much to say that the man who has not done this cannot properly estimate the intellectual characteristics and tendencies of the age. Philosophy, as we have seen, aims to reduce all causes to one cause, all laws to one law, and all phenomena to one primordial source of being, that man may see the many in the one, and the one in the many. The Synthetic Philosophy claims to have done this by establishing the universal law of Evolution. For this reason Mr. Spencer has termed his system the Synthetic Philosophy, because it aims to construct by means of the law of Evolution a harmonious and consistent *organon* out of all the departments of knowledge.

To one not correctly informed, the word Evolution is full of materialistic and atheistic associations, as though it were a denial of the spirituality of man and the existence of God. Nothing can be farther from the truth than such an idea. Evolution, so far from aiming to set aside the idea of a first Creative Cause, claims to be the manifestation of a Power which no human thought can fully comprehend. It teaches that the postulate of Absolute Being is alike essential to both science and religion. "Both religion and science," says Mr. Spencer, "are obliged to assert the existence of an Ultimate Reality. Without this religion has no subject matter; and without this science, subjective and objective, lacks its indispensable datum." Persons having only a partial knowledge of the Synthetic Philosophy have made the mistake of supposing that it makes *force* its ultimate postulate, and that hence the idea of Absolute Being or God is rejected. This mistake is less excusable from the fact that Mr. Spencer has used great clearness and fullness of statement to prevent his readers from falling into this very error. He says, "Over and over again, it has been shown in various ways that the deepest truths we can reach, are simply statements of the widest uniformities in our experience of the relations of matter, motion and force; and that matter, motion and force are but symbols of the Unknown Reality." We thus see that *force* is not the Ultimate Reality, but the symbol of the Ultimate Power which ever works throughout all nature, and "in which we live and move and have our being." No philosopher goes beyond Mr. Spencer in emphasizing Absolute Being as the ultimate datum of all science, philosophy and religion. He says: "By the very conditions of thought we are prevented from knowing anything but relative being; yet by these very conditions of thought, an indefinite consciousness of Absolute Being is necessitated." He, in common with all other philosophers, makes Absolute Being the ultimate principle of philosophy; the only difference being that while they ascribe to this Ultimate Power personal attributes, he regards this as unknowable, and hence as not admitting of the predication of such attributes. He says: "All philosophers avowedly or tacitly recognize this same ultimate truth:—that while the Relativist rightly repudiates these definite assertions which the Absolute makes respecting existence transcending perception, he is yet at least compelled to unite with him in predicating existence transcending perception." While regarding Absolute Being as only indefinitely apprehended by consciousness, its existence is with him none the less certain. He says: "The existence of this inscrutable Power is the most certain of all truths."

In developing his comprehensive system of phllosophy, it devolved upon Mr. Spencer, at the outset, to define what he regards as the true scope of philosophy. Regarding philosophy as a synthesis of the most general truths of science, while science itself deals solely with proximate, not ultimate causes, it follows that the findings of philosophy from his stand-point are confined to the sphere of such causes as are manifested in the uniformities of cosmical phenomena. Hence, the Synthetic Philosophy does not, like the German Philosophy, enter the sphere of Ontology, and attempt to explain the mysteries of Absolute Being. Regarding such a task as beyond the powers of the human mind, it confines itself to the sphere of the finite and relative. It attempts through the law of Evolution to unify the various orders of cosmic phenomena—to show how the different sciences, such as astronomy, geology, biology, psychology and sociology, can be logically articulated into a single harmonious and consistent body of established truth through one fundamental and all-pervading law or principle. Hence, the merits of this philosophy must be judged solely by its success in bringing within this comprehensive synthesis all the various ranks and orders of cosmic phenomena. Mr. Spencer terms his system the Synthetic Philosophy for the reason that its great organizing law is Evolution, within the comprehensive synthesis of which all cosmic phenomena find their unity and explanation. Prof. Fiske, the able expounder of this system, prefers the term *Cosmic*, for the reason that it distinguishes this system from those ontological forms of philosophy which treat of Absolute Being. Any one is at liberty to raise with Mr. Spencer an issue regarding the possibility of constructing an Ontology; but this would be a psychological question concerning the powers of the human mind. Such a question would no more involve either the truth or the untruth of the evolution philosophy than the old question concerning the nature of gravitation—whether it is due to action at a distance or to ethereal pressure, involves the truth of the Newtonian system of astronomy. Modern astronomy rests on the *truth* of gravitation as the great law of space, and not on any theory concerning its ultimate nature. In like manner, Evolution as the great law of time, rests on the persistence or indestructibility of force, regardless of any theory we may hold concerning the nature of Absolute Being, of which force and motion are to us but the sensible symbols. We may agree with Mr. Spencer in denying that personal attributes can be predicated of this Power, or we may, in common with many evolutionists, predicate of this Power such attributes, and still hold to the theory of Evolution. This theory concerning the relativity of knowledge was borrowed by Spencer from Hamilton, and hence does not enter as a logical element into the formula of Evolution.

These are distinctions which need to be made if we would form a just estimate of the merits of the Synthetic Philosophy. Evolution claims to be an explanation of proximate causes, laws and origins, not of ultimate ones. The opponents of evolution seem utterly unable or unwilling to understand this distinction. Even Agassiz, who ought to have understood this, failed to do so in his latest utterances. He says: "How the world originated is the great question, and Darwin's theory, like all other attempts to explain the origin of life, is thus far merely conjectural." Darwin's theory, which is a special phase of evolution, does not attempt to explain the origin of life, but the *origin of species*. Again, it is manifestly unfair to criticise adversely the Synthetic Philosophy for its failure to construct an ontology which shall explain ultimate causes and origins. The merits of a science or philosophy should be judged solely by its success in dealing with those questions which belong to its own self-chosen sphere of thought. Such a confusing of the question is to be regretted, both for the sake of science and theology. It brings issues into scientific discussion which have no business there, by confounding proximate and ultimate causes. It does harm to theology by exciting in the minds of religious people needless fears, causing them to regard science, and especially evolution, as hostile to their religion.

Now, to properly understand Evolution, we must view it as the law which formulates *successions* in time. Whether it is the savage or the philosopher who looks out upon the face of nature, the most imposing and impressive feature is *motion*, or ceaseless activity. All Nature is one vast rhythm of action and reaction, endless processions and recessions. Amid this perpetual conflict of forces, this continual becoming and ceasing to be, land and sea are ever striving for the mastery. The sea is ever being carried away in the form of vapor to the tops of the hills and the mountains, while the hills and the mountains, the symbols of durability, are slowly but surely traveling to the sea. Nature, "red of tooth and claw," has ever been hunting down without pity or remorse the living forms which make up the long procession of life. Man and his works, like all below him, are ever whirled onward in this mighty torrent of change which allows nothing to endure in fixed and stable form. We mark the ages of history by the different types of men and civilizations which have risen and flourished during their brief day, and then disappeared to be succeeded by new phases in the movement of Humanity. We thus see event following event, the cause ever passing into the effect, and the antecedent becoming incorporated into the consequent amid the ceaseless successions of time.

But the savage and the philosopher assume toward these ceaseless changes of nature very unlike mental attitudes. In the mind of the one those varied phases of nature form an undiscriminated congeries of impressions, with no fixed law or order; in the mind of the other there is an abiding conviction that amid all the manifold changes which make up the world of phenomena, there is in the innermost determination of things a unity of plan ever working toward the realization of definite ends. To the savage, nature is a Sibyl whose scattered leaves have no meaning; to the philosopher who carefully collects her leaves and places them in their true connection, she reveals the mysteries of ancient time. To trace out the genetic successions and correlations in cosmic phenomena, to show how one stage or epoch has unfolded out of its antecedent, and how this, in turn, will unfold into its consequent—in a word, to formulate the universal law of *sequence* which holds in all orders of phenomena, is the object of the law of Evolution. We agree with Prof. Le Conte in regarding Evolution as the grandest idea of modern science, embracing, as it does, at least one-half of all science, and this by far the most interesting and important half. "A most valuable habit," says Mr. J. J. Murphy, "has become general among men of mental cultivation, of regarding every object, not as if it were alone and isolated, but in its connection with other objects." Man as a being "looking before and after," in order to satisfy the demands of his mental nature, earnestly desires to know the causes which have operated to produce the present order and relation of things. The mind accepts as a satisfactory explanation of any class of phenomena when it knows the dynamic laws, by the operation of which cognizable objects acquire and lose the sensible forms under which they assert themselves to consciousness. This manner of investigation, made familiar by Evolution, is termed the *genetic* method, because it investigates phenomena in their historic successions as manifested in the relations of each phase of a subject to preceding and succeeding phases. The phenomenon which at a particular period of time manifests itself to us does not reveal the totality of its nature, properties and relations. The genetic method, going back by *analysis*, tends to reduce diversities to a primitive identity, and advancing forward by *synthesis* finds the primitive identity disappearing in diversity. By the former process science reconstructs the past; by the latter it constructs the future. By this method we interpret the present by the past, the complex by the simple, and the fully developed product by the rudimentary form.

This desire of man to know the past and to connect it organically with the present accounts for the fact that Evolution has been so generally received by the thinking class of persons. This law offers the only rational solution which our faculties permit us to perceive as to the mode of origin of the present cosmical order from primitive, antecedent conditions. From the time that Newton taught mankind to modify their idea of cause into the conception of *mechanical force*, and thence to look at nature from a dynamic point of view, the scientific mind has been advancing with sure step to Evolution as the final, logical outcome. To understand Evolution, we must study its fundamental characteristics. But it is from biology, the fundamental category of which is *organism*, that we get our clearest conception of those essential characteristics which constitute evolution, or development. The growth of a plant or an animal from the simple germ "is the typical specimen of a phenomenon which rules through the whole course of the history of man and society—increase of function through expansion and differentiation of structure by internal forces." It will then be best to define and illustrate the fundamental characteristics of Evolution from the standpoint of organic phenomena.

1. *The homogeneous:*—Embryology has revealed the fact that the complex animal organism is developed from a simple germ which, because of a sameness of structure, is characterized by the term *homogeneous.* "However much," says Beale, "organs and their tissues in the fully formed state may vary as regards the character, properties and compositions of the formed material, all were first in the condition of clear, transparent, structureless living matter." But this homogeneous, structureless protoplasm is unstable, and must therefore differentiate itself, or develop into an unlikeness of parts, because of the vast amount of locked up energy which it contains. Hence, it assumes a dynamic relation to itself, in order that it may unfold into its higher self, and realize the ideal of growth and development stamped upon its inmost constitution, and which is but the full unfolding of the promise and potency enfolded in the original germ.

2. *The heterogeneous:*—The final state into which the homogeneous and structureless matter of life unfolds is characterized as *heterogeneous.* This final state, in contrast to the primitive simplicity out of which evolution arises, is characterized by a structural difference among the coëxistent parts which become endowed with diverse functions. In the primitive homogeneous state there is no definite and coherent relation among the parts. In the final heterogeneous state, sameness has developed into diversity, simplicity into complexity, in which there is a definite and coherent relation among the parts.

The vital movement by which life passes from this primitive simplicity to its final complexity is a double movement, and is expressed by the terms *integration* and *differentiation.*

3. *Integration:*—By integration is meant in Evolution the process by which the different parts of a structure or organsm are knit together into organic unity through their mutual dependence and coöperation. The degree of coherency and dependence among the different parts of an evolved structure is determined by the degree of complexity and specialization of functions. An increasing specialization among the functions brings with it an increasing efficiency, and, at the same time, an increasing dependency and coherency, for the reason that as each organ becomes more specialized, it is less able to perform any other than its own allotted function. Some living beings, as the *amœba,* are so low down in the scale of life that they have no specialization of parts. Foot, head and stomach are extemporized for the occasion. Integration is consequent upon a loss of motion, so that the different parts are allowed to come into combining and coöperative relations.

4. *Differentiation:*—By differentiation is meant in Evolution the process by

which an unfolding structure becomes endowed with diverse functions. By virtue of the marvelous changes due to differentiation, two vital germs, apparently similar in nature, develop into two living beings widely dissimilar in form and nature; one may develop into the serpent which crawls in the dust, the other into the bird of-paradise which makes the forest glorious with its beauty. Integration and differentiation in organic evolution supplement each other. Without the former there would be no organic unity, but a mere assemblage of parts, each existing and acting for itself. Without the latter there would be no specialization of structures and functions, but a mere aggregation of parts.

These principles, as worked out by Mr. Spencer, constitute the essential characteristics of evolution, which, as he has shown, applies to all orders of phenomena, whether organic or inorganic, as the universal law of the redistribution of matter, force and motion. We may define thus: *Evolution is an orderly and successive series of changes from a simple and homogeneous state to one that is complex and heterogeneous, through the twofold process of integration and differentiation consequent upon a loss of motion.*

It has been said by its opponents that Evolution is only a hypothesis. This we admit; but no one acquainted with the logic of science would argue from this that it should be regarded as false. If sustained by facts, if it explains what would otherwise remain unexplained, while, at the same time, it is not contradicted by any known principle of nature, then a scientific hypothesis is to be regarded as true. Science is largely built upon hypotheses of this character, such as the undulatory theory of light, and the molecular and atomic theories of matter. As to absolute certainty, this is beyond the powers of inductive investigation, as we are taught by the ablest writers on the logic of science. "The theory of Spencer, says Prof. Jevons in his work on *The Principles of Science*, "is to some extent hypothetical, just as all the theories of physical science are to some extent hypothetical, and open to doubt. Judging from the immense numbers of diverse facts which it harmonizes and explains, I venture to look upon the theory of evolution in its main features as one of the most probable hypotheses ever proposed."

Mr. Spencer, by an induction of facts never before equaled for the variety and extent of learning which they display, has shown how all those phenomena which involve questions of genesis or succession find their explanation and organizing law in Evolution. That the solar system had a nebular genesis is now, we may say, universally received by astronomers According to this theory the system had its origin out of a homogeneous and incandescent vapor, which rotating about a center passed through successive changes consequent upon a dissipation of motion in the form of heat. As the rotating mass cooled, there was integration; when this process had reached a certain stage, rings were thrown off from the more rapidly revolving equatorial regions, which gathered into planets. Here was differentiation. The central and larger portion being less condensed on account of its retained heat, formed the sun. Here we have evolution on a grand and imposing scale. The truth of the nebular theory has of late years received a most remarkable confirmation from the revelations of the spectroscope. When Galileo pointed his telescope to the planet Jupiter, and beheld his four moons revolving round their central world, the Copernican theory received a confirmation which its opponents could not withstand. In like manner, when the spectroscope was brought to the aid of astronomy, the theory of cosmic evolution received a confirmation which almost commands acceptance. Far off nebulæ yield a spectra which prove them to be incandescent gas in different stages of evolution,—embryo worlds which are now passing through the same successive phases of development as was once the case with our own system.

Geological evolution is mainly distinguished from astronomical by the fact that it is chiefly due to the disturbing influence of radiation from foreign bodies, principally the sun. The facts of geology go to prove that the earth was once a reservoir of intense heat, which produced a repulsion among its elements, so that it "was without form and void," or, in scientific language, a structureless mass with no definite arrangement and dependence among its parts. While this high temperature lasted, it must have been a time of universal tropics, so that there could have been no spring, summer, autumn and winter. Variety among the seasons arose from the loss of heat, so that the earth's "external temperature began to depend chiefly upon the supply of solar radiance." Thus the continual loss of heat producing integration, and the heat retained in the central mass producing differentiation in structure gradually developed the earth into its present variety and dependence of parts. Thus arose its internal structure, and also those systems of moving equilibrium in its water and atmosphere upon which depend its different climates and seasons. The facts and principles which now form the beautiful and imposing edifice of geology were a mere mass of materials without method or order until they found their logical relations and explanations in the guiding principles of evolution.

With regard to the application of evolution to organic phenomena, space will allow only a few brief statements. We make these more especially for the purpose of pointing out some of the misunderstandings which continually beset this aspect of the subject. Organic evolution is often spoken of by its opponents as though it were intended to set aside the idea of a Creator. Nothing can be farther from the truth. Evolution raises no question as to the ultimate origin of the world; admitting this with all its forces, physical and vital, to have sprung from a divine Creator, the question it has raised is one solely concerning the method of the divine procedure in the production of the wondrous forms of matter and life as we know them. Hence, the whole issue in organic evolution, as raised by Darwin, is one about the origin of existing species, whether these are supernatural creations by direct *fiats*, or have been developed from pre-existing species by the workings of natural causes. The prime object in his work on the "Origin of Species," as he himself states, was "to show that species had not been separately created."

A fundamental difference between the old and the new theory of biology is that while the former endeavored to explain the diverse forms of life on teleological principles, the latter regards environing relations as an essential factor in solving such problems. Between the organism and its environment there is a continual interaction which must, in the course of long ages, produce specific and well marked modifications. The law of Natural Selection, as proposed by Darwin as an explanation of the manner in which present existing species have been developed from pre-existing ones, is based on the principle of adaptive changes which organisms must undergo in order to adjust themselves to changes in environing relations. The truth of this law derives strong support from the consideration that organisms are not such fixed and immutable forms as they were formerly supposed to be. It is clearly shown that this was especially the case during geologic time when types were *fluent*, so to speak, and less subject to the law of limit, so that there was a transformation of one species into another. During the mesozoic period geology shows that there were *comprehensive* types in which fish, reptile, bird and beast seemed to flow into one another. The law of Natural Selection is not inconsistent with the operation of other causes in the development of species. Wallace, Mivart and LeConte, while assigning to this law an important sphere of action, contend for other causes, even supernatural *fiats*. Evolution is the only hypothesis which affords an explanation of the empiric principles of biology. As the undulatory theory of light is the only hypothesis capable of explaining all the facts in the case, so Evolution is the only hypothesis which has yet been offered capable of explaining the successions of species during the life-history of the earth. Evolution, having no rival theory as to the origin of species, has been almost as generally received by biologists as the undulatory theory of light has been by physicists. As to the account of the miraculous creation in the first chapter of Genesis, this sets up no rival theory against evolution, for it leaves the origin of species an open question. The continuity and succession of events implied in evolution are not inconsistent with occasional manifestations of supernatural power. This occasional manifestation of supernatural power in the form of *fiats* is all that is taught in Genesis. The entire organic world was due to three *fiats*, one for the creation of vegetable life, one for the creation of animal life, and one for the creation of man. But it is plainly implied that these miraculous *fiats* were instantaneous manifestations of divine power, while geology teaches that the development of the myriad forms of life was a long process, extending over countless ages, during which time organic species arose in an ever advancing gradation. While, then, the beginning of those long periods termed days was marked by a supernatural *fiat*, their duration was an unbroken evolution of the effects of those fiats, during which the successions of life, from species to species, went forward according to the working of natural law. There is, therefore, no reason why evolution should not be recognized as a fundamental principle of theology as well as of science, so far as the former needs to recognize any theory regarding the *method* of creation. The evolution of the organic kingdom seems like a continually ascending spiral rising into ever widening cycles of multiform life, which now and then by the accumulation or *creation* of force starts forth into sudden and paroxysmal forms of development.

Evolution is now received as the working hypothesis in biology by which are settled all questions concerning organic types and classifications. Classifications in biology are no longer, as formerly, based on external and non-essential resemblances, but on essential *genetic* relationships. On this point Prof. Gray, our most eminent American botanist, says: "Taken as a working hypothesis, the doctrine of the derivation of species serves well for the co-ordination of all the facts in botany, and affords a probable and reasonable answer to a long series of questions which, without it, are totally unanswerable."

But in no department of investigation has the success of evolution in solving difficult problems been greater than in psychology. One of the great problems of psychology from Plato to the present time has been to explain the correspondence between the world of mind and the world of things. Now, if a theory is to be tested by its ability to explain questians which all others have failed to answer, then Evolution should be regarded as possessing the highest scientific value. The theory of evolution explains the intuitions or innate forms of thought in a manner so satisfactory as to make all previous efforts appear fanciful. It views the mind, not as a metaphysical entity acting in *vacuo*, but as a definite structure, an organism, eudowed with special facilities which have been moulded into their present form through a continuous interaction with environing forces. The effects thus produced by the law of heredity are transmissible, so that what was ancestral experience becomes in the individual an innate endowment of mental faculty. Hence, the correspondence between the mental faculties and the external world must be interpreted as due to the latter acting on and modifying the former in conformity with itself. Mind is thus brought within the category of organism, the fundamental law of which is Evolution; and as a complex structure due to the workings of this law, it grows and develops in conformity to surrounding forces and conditions.

In view, therefore, of the great variety of proof in support of Evolution in which all the various orders of cosmic phenomena find their unity and explanation, we think the Synthetic Philosophy may justly be regarded as the *organon* of the sciences, as indicated in the title of this essay.

It is feared that the Danish steamer Oscar Dickson, with an exploring party, has been lost in the Siberian Polar Seas. This is the Sweedish vessel which was named after Dr. Dickson, of Gothenberg, Sweeden, who equipped the last expedition of Prof. Nordenskjold.

ARCHÆOLOGY AND ANTHROPOLOGY.

SCHLIEMANN'S DISCOVERIES AT TROY.

JAMES MACALISTER.

The name of Dr. Schliemann has been so prominently before the public for a number of years that most persons know something of his eventful life and the discoveries associated with its later years. It is doubtful, however, if the magnitude of the work he has performed, and the vast importance of the results he has obtained, are generally understood. No one man has ever accomplished so much in the field of archæological research, or contributed so largely to the solution of problems which have an undying interest for all intelligent minds. With an enthusiasm and a forgetfulness of self rare among men, he has devoted his hard-earned wealth and the prime of his manhood to the elucidation of the immortal poems that have charmed and instructed the world for three thousand years; and to him more than to any other man is due the feeling of certainty with which we can now regard these poems as historical records of a period that has hitherto been regarded as purely mythical.

It is seldom that the whole life of a man stands so closely related to the achievement which has brought him honor and fame as is the case with Schliemann. Born in poverty, and receiving but a limited education, he early formed the resolution to master the poems of Homer, and to discover the city beneath whose walls the battle of the *Iliad* took place. To find Troy was the dream of his boyhood—a dream which, through all the shifting scenes of his career, never forsook him, and to the realization of which he decided, at the age of forty-four, to give up the remainder of his days and the fortune he had gathered for this purpose. While following the business which made him rich and procured him leisure, he kept the great aim of his life constantly in view, and fitted himself by the study of languages and history for the undertaking which, on retiring, he was ready to begin. In 1864 he relinquished commercial pursuits; and after five years spent in travel and in preparatory study at Paris, he repaired to the Trojan Plain to commence the excavations which have made him famous. With the exception of the time spent at Mycenæ, he has ever since pursued his researches there, carrying on extensive diggings at great expense, and seeking by various publications to make the world acquainted with the results of his labors. Altogether he has given about five years to the excavations at Troy.

The chief purpose of Dr. Schliemann's labors has been the verification of the Homeric legends concerning Troy. It was an object worthy of the noblest endeavors of his enthusiastic nature. Where did the "Sacred Ilios" stand? Is Troy a myth; or was there really a city where Priam ruled, which was conquered, despoiled, and burned by the Grecian hosts? Was the Ten Years' War, with its mighty deeds of arms, a fiction of the poet's brain? Did Homer invent the scenes, the events, the men and women, of the *Iliad?* These are the questions which this intrepid explorer in the field of classic legend took upon himself to answer. He had a profound faith in Homer—an unwavering belief in the reality of his narrative; and the task he undertook was to prove the objective correspondence of the little corner of land in the extreme north-western corner of Asia Minor with the poetic description of the *Iliad*, and that the hill of Hissarlik is the very place where stood the "Holy City" around which was enacted the "Tale of Troy Divine."

If the reader will look at a classical map of the country around the Hellespont, he will find in Troas a point south of the strait (the actual distance is three miles) marked Novum Ilium. On modern maps this name will be changed to Hissarlik. For centuries after Homer's time, this was the accepted site of Troy. But about 200 B. C, a writer known as Demetrius of Scepsis challenged the identity of Novum Ilium with the ancient Ilios of Homer. His arguments were of the flimsiest character; but, unfortunately, his views were adopted by Strabo, the geographer, whose authority was respected till the end of the last century. It is not certain where Demetrius and Strabo placed the site, but it is supposed to have been at a place now known as Akshi Kioi (rather more than four miles in a direct line southeast of Hissarlik. In 1785, Lechevalier, a French traveler who had made a hasty examination of a portion of the Troad, put forward claims for a place called Bounarbashi as the spot where Troy had stood in the days of its strength and glory. Nearly sixty years ago an attempt was made to revive the identity of Novum Ilium with the Homeric Ilios, by Maclaren, an English writer. Since then scholars have disputed over the conflicting claims of Novum Ilium and Bounarbashi, and there is no saying how long the controversy might have continued, had not Schliemann gone to work with pickaxe and spade, and applied the sure inductions of archæological science to the settlement of the question. He has spent years in laying open the soil at both places, and has produced incontestable proofs in favor of the place which Greek tradition had asssociated with the story of the *Iliad.* Three feet below the surface of the hill at Bounarbashi he struck the solid rock, and there were neither ruins nor remains to show that any city had ever stood there. Mr. Philip Smith has said that "the theory of Lechevalier is a mere hypothesis, born from the fancy of a modern traveler, without the slightest historical or traditional foundation." To this might be added that not a single fact or principle of archæology can be quoted in support of the Frenchman's theory.

Dr. Schliemann went to work in a very different spirit, and pursued very different methods, from any of his predecessors. He organized an extensive establishment at Hissarlik, and labored with a zeal that knew no bounds. His excavations extend to a depth of 52½ feet from the surface. In penetrating to this depth he passed through a series of seven strata, differing from each other in many particulars. In his opinion these strata correspond to a succession of cities that have arieen one above the other through long periods of time. The lowest stratum goes back to a prehistoric age which must have antedated the Trojan war by many centuries; the highest stratum was the site of the Hellenic city of Novum Ilium. It is the third stratum, thirty-three feet from the bottom and ten feet thick, which Schlieman identifies as the Homeric Ilios. Here he claims to have found the ruins of a city which answers to all the requirements of the *Iliad*, and it is to the substantiation of this claim that his book is devoted. It would be sheer presumption to think of summing up in a few lines the immense mass of facts and reasoning gathered in the eight hundred pages of the work; but we may venture to state in the briefest form the principal propositions by which the conclusion is obtained.

First—The position of the hill of Hissarlik answers nearly all the demands of the *Iliad* as to the topography and scenery of the surrounding country, in which the action of the poem is represented as taking place.

Second—The structure and arrangement of the ruins of the third stratum which have been laid bare correspond to a remarkable extent with the descriptions of the poem.

Third—The place bears the strongest evidence of having been destroyed by a great conflagration, and in this respect furnishes peculiar evidence of its identity with the city which Homer describes as having been given to the flames by the victorious Greeks.

Fourth—The ten treasures of gold and silver found in or near the principal house prove the city to have been the residence of a powerful and wealthy chief—such an one as Priam is described to be in the poem. These treasures afford good ground for the epithet "City of Gold," so frequently used.

Fifth—The archæological remains of all kinds found in such abundance are such as naturally belong to the age which can fairly be assigned to this third stratum of the excavations, and correspond with great exactness to the descriptions of the *Iliad*.

Sixth—The historical testimony, to which allusion has already been made, is strongly corroborative of the disclosures made by the excavations at Hissarlik. It is not likely that Xerxes would have visited Novum Ilium to make libations to the heroes slain in the Trojan war, or that Alexander would have come thither to offer sacrifices to Priam when on his way to the East, if the traditions which connected Novum Ilium with the Troy of Homer had not been well founded and universally believed.

It is not pretended, of course, that the topography and remains of the third city unearthed at Hissarlik correspond in every particular with the pen of Homer. It must not be forgotten that Homer deals with his matter in the large and imaginative manner of the poet. Still, the agreement is much more striking than would be suspected; and, taken together, the propositions stated above make out an overwhelming case in favor of Schliemann's views. As Professor Virchow has well said, "It is not left to our choice where we should place Ilium; therefore we must have a place which answers to all the requirements of the poetry; therefore we are compelled to say: *Here*, upon the fortress-hill of Hissarlik—*here*, upon the ruins of the burnt City of Gold—*here was Ilium*."

Closely connected with the problem as to where Troy stood are other questions of fascinating interest. It is but a step to the inquiry whether the persons and incidents described in the *Iliad* are to be treated as myths or regarded as historical facts. There is no room for the discussion of this question here; but we may be permitted to remark that since the publication of Dr. Schliemann's researches but few scholars of eminence have cared to speak of the *Iliad* as nothing more than a collection of poetical fictions. All, indeed, are not willing to follow Mr. Gladstone in yielding to Homer an historical authority quite equal to that of Herodotus. But that the Trojan war was an actual struggle, "some scene of that act of the warfare between Europe and Asia which made the western coast of Asia forever Greek," as Mr. Freeman puts it, is a proposition entitled by every canon of historical criticism to unqualified acceptance. The traditions woven into poetic form by Homer must have rested upon a solid basis of fact. Transformed to a very considerable extent they no doubt were by "the vision and the faculty divine" of the poet; but we cannot close our eyes to the literal exactness with which many of Homer's lines fit into the facts revealed by Schliemann. Henceforth we may have the satisfaction of feeling that Homer was not only mighty in fancy—the inspired singer of the "ways and workings of the Olympian gods"—but a trustworthy narrator of historic events. Achilles and Hector may be names invented by the poet; but we may be sure that they stand for heroes who actually engaged in deadly strife before the walls of Priam's city. We get from Professor Virchow, a scientific observer of nature, so complete an idea of the Trojan plain and the surrounding scenery, as seen from Hissarlik, that it seems almost impossible to read the *Iliad* now without realising that it is not all fiction. We can stand upon "Ilion's towers" and view Mount Ida, "rich in springs," where Zeus, the "cloud-compeller," dwelt; the heights of "woody" Samothrace, the seat of "earth-shaking" Poseidon; the "flowery mead" through which the "eddying" Scamander hurries to the sea; the Hellespontine shore where the ships of the Achæans lay beached in "double rows." We can sit in the place where Priam, with his "sage chiefs and councillors," watched

"the glorious deeds
Of Trojan warriors and of brass-clad Greeks."

And we can walk through the "Scæan Gates," where Hector of the "gleaming helm" took a last farewell of the "fair" Andromache. Surely these glorious memories are not all the mere fancies of a poet's mind! Surely the war of Troy must be real history! Surely this is Troy itself, dismantled and burnt by the fury of the victorious Greeks!

But there is still another question connected with Schliemann's discoveries which must not be allowed to pass unnoticed. Even if it should be granted that Troy had a real existence, and that the Ten Years' War is an historic fact, the problem of Homer himself would still remain to be settled. Was Homer a real person? When did he live, and to what country did he belong? Are the Homeric poems the work of one poet or of more than one? Are the *Iliad* and the *Odyssey* by the same person? Is the *Iliad* one poem, or was it formed by the insertion of certain books in an earlier *Achilleid?* These are not new questions, and they exist quite independently of Schliemann's explorations. But these explorations throw a flood of light upon the Homeric problem. We need scarcely say that Schliemann believes in the actual existence of Homer and the substantial unity of the Homeric poems; and his researches, and the use which has been made of them by scholars, have immensely strengthened this side of the controversy. The archæological knowledge we now possess all goes to show that while Homer, to use the language of Mr. Gladstone, "was neither contemporary nor denizen of Troy," he must have been familiar with the city and its surroundings, and that he could not have been far removed in time from the events of which he sings. Dr. Schlieman is exceedingly guarded in his statements concerning the time and place of Homer; but we are inclined to think that Virchow does not speak too strongly when he says that "the *Iliad* could not have been composed by a man who had not been in the country of the *Iliad*"; that the "bard must have stood upon the hill of Hissarlik and have looked out thence over land and sea," and that "in no other way could he probably have combined so much truth to nature in his poem." And the learned professor does not believe it possible that "a poet living at a distance could have evolved out of his imagination so faithful a picture of the land and people as embodied in the *Iliad*."—*The Dial.*

AMERICAN POTTERY.

PROF. F. W. PUTNAM.

Twenty-four years ago Professor Swallow, of Missouri, explored two mounds near New Madrid, in the southeastern part of that State, from which he obtained about a hundred specimens of pottery and numerous other objects. This collection was secured by the Peabody museum of Archæology at Cambridge in 1874, and was briefly noticed in the Eighth Report of the Museum. At the time of its purchase the "Swallow Collection" was considered of great value and importance, as comparatively few objects of pottery were then known from the mounds and ancient burial places of the Southwestern States. Since then many of the mounds of Southwestern Missouri and of the adjoining portions of Arkansas have been more or less thoroughly explored, and there are now probably from fifteen to twenty thousand objects of pottery in public and private collections which were obtained from that region, and are known to the archæologists under the general term of "Missouri Pottery." Although this peculiar type of pottery has received its name from first having been found in abundance in the New Madrid region, it would be incorrect to imply that pottery of the same general character is limited to that locality; for it is also known to be more or less abundant, here and there, throughout a large portion of the country drained by the central and lower Mississippi and its tributaries. Each little center in this designated territory, however, has its local peculiarities; just as we should expect would be the case in the work of a widely spread people subdivided into tribes and villages, but deriving the knowledge of the art from a common source.

A thorough acquaintance with this type of pottery, from its comparative abundance, wide distribution and peculiar forms, is of great importance in American archæology; and the Archæological Section of the St. Louis Academy has done a good work in placing within reach of all students the present elaborately illustrated memoir,* which is the first of a series on the archæology of a region that is exceedingly rich in prehistoric and early Indian remains.

The memoir is divided into two sections. In the first part W. B. Potter gives an interesting account of the position and character of the earth-works and mounds in the southeastern portion of the State of Missouri, including an important geological account of the great "Swamp Region" in which they are found. Accompanying this part of the memoir are five maps, showing the location of the old settlements on the "ridges." These settlements are surrounded by embankments and ditches, and include most of the mounds which were explored by members of the Academy.

The pottery obtained from them is described by Dr. Edward Evers in the second part of the memoir, accompanied with twenty-four lithographic plates, upon which are represented over one hundred and forty vessels of various shapes and different styles of ornamentation, which were selected for illustration from over four thousand specimens, belonging principally to the collections of the Academy, Dr. Engelmann, and Prof. Potter.

In common with the pottery from many other and widely distant nations and countries, many of the vessels from the Missouri mounds can be classed as water-bottles, bowls, dishes, and jars, and pots with or without handles. Occasionally a vessel is found which has a general resemblance to a form that is common to some other locality, and leads one to speculate on the possibility of a transmission of the form from a widely separated people, or on the possibility of the individual occurence of the same ideas, expressed by the peculiar design, among people who were far apart. This thought will probably occur to many on glancing over the illustrations in the volume, when the general resemblances between many of the Missouri vessels and those from Central America and Peru, and the early Asiatic and Egyptian forms, will be apparent; but when the vessels themselves are studied, the method of their manufacture, the peculiarities of their ornamentation, and many little technicalities, will show a far greater divergence in the art itself than is expressed by the simple occurrence of identity in form and the realistic ornamentation common to many nations during corresponding periods of development.

It is hardly necessary to state here that the Missouri pottery was made with-

*Contributions to the Archæology of Missouri, by the Archæological Section of the St. Louis Academy of Science. Part I. Pottery.

out the use of the wheel, and is not glazed. Much of it is well burnt and is comparatively thin and hard. Probably the kiln was not used, and the hardening was done entirely by heating over coals or burning in an open fire. Dr. Evers mentions much of the dark pottery as simply sun-dried, but a series of experiments has led me to the conclusion that this is an error, and that simple sun-dried specimens are seldom found. The dark-colored vessels are unquestionably very near the natural color of the blue clay of which they are made, but this color is not changed unless the color is subjected to considerable heat. The slight luster on the vessels was probably produced by polishing the surface with a smooth stone while the clay was soft, as is still done by many Indian tribes in America.

Much of the Missouri pottery is ornamented by waved lines, circles, and stars, and other simple and symmetrical designs, in red, white, and black; but these colors were put on after burning, with a few exceptions, and are only well preserved under favorable conditions. In some of the red vessels the color was burnt in. Common incised lines and designs, and "punch" and "nail" ornamentation, also occur.

The most important and interesting of the vessels are those that are modeled after natural forms which they faithfully represent, such as the gourd-like bottles and shell-like dishes, and those in which the design in ornamenting the vessel is to give the characteristics, if not the forms, of fishes, frogs, birds, beavers, panthers, bears, and other animals, as well as of men and women. Of such forms the plates in the memoir give many characteristic examples that are well worth a study.

In this brief notice of the work it is only intended to call the attention of the readers of the REVIEW to the first important memoir that has appeared on the as yet little known pottery of America, and to ask for it the attention which the subject demands. The time has at last come when the antiquities of our country and the remains of former Indian tribes are beginning to receive careful attention, and wild speculations and loose statements are giving way before the accurate presentation of facts. Such memoirs as the present will do much to put the knowledge of the archæology of America before the public in a proper way, and we can but offer our congratulations to the gentlemen of the St. Louis Academy who have presented a portion of the results of their explorations to the public in this modest, conscientiously written, and well-illustrated memoir. May its reception be such as to secure the publication of the other numbers of the series as proposed.—*American Art Review.*

INDIAN TRADITIONS RESPECTING THEIR ORIGIN.

T. L. LEWIS—BOLIVAR, MO.

Almost every tribe has its own peculiar idea of the "origin of man." Many of the South American Indians, as well as most of our Southwestern tribes, represent, in their traditions, their fathers as issuing from caves, springs or lakes, which accounts for the peculiar veneration they have for springs, caves and lakes.

In Peru the natives of the valley of Xanca claim to be the descendants from a man and woman who came out of the spring of Guaribalia; those of Cuzco, that they came out of Lake Titicaca, while those of the valley of Andabayla say that they came out of Lake Socdococa. There is also a Peruvian tradition that after the flood six people came out of a cave and re-peopled the desolate earth.

The Caddoes, Ionies and Ahmandankas of Texas had a tradition that they issued from the Hot Springs of Arkansas. The Mandans and Minnetaries, on the Missouri River, say they came out of a large cavern.

The Appalachian tribes claim to have originated at an artificial mound on the Big Black River in the Natchez country.

De Smet tells us of a tradition among the Blackfeet which is romantic as it is peculiar. There are two lakes, the Lake of Men and the Lake of Women. From the one man had his origin, the other woman. Upon the first meeting of the sexes the men struck up a sharp bargain with the women, in which the latter were outwitted and reduced to perpetual drudgery. The men proposed to become their protectors on the one condition that they would assume all the household care and drudgery.

The Ute Indians tell of a beginning when the earth was covered with mist, which the Great Spirit dispersed it with the bow and arrow, and found the earth uninhabited. He then took clay, fashioned man, and set him to bake, but as it was only an experiment, the fires were not hot enough, so he came out white—a white man. The Great Spirit tried it again, with a more intense heat. Leaving him to roast a long time, he came out black—the negro. He then fashioned one with greater skill, and after the most careful baking, he came out red—the red man, the first Indian—the most perfect type of manhood.

Some others claim an animal origin, as the Toukaways of Texas, from a mole; the Lenni Lenapes or Delawares from a snail which inhabited the banks of a large river which had its source in the mountains near the rising sun. The Choctaws assert that they were originally crawfish. One day a part of the family were out enjoying the sun and were carried away and became Choctaws. The remainder are yet under the earth. Such is the general character of their traditions.

Dr. George M. Beard repeated in the New York Academy of Sciences his interesting mesmeric experiments with the patients whom he has specially trained for this purpose. The results were again most interesting and astonishing. Artificial catalepsy was produced, and each of the senses temporarily suspended at will. The experiments in the production of local anæsthesia were particularly interesting; a small spot in the face of one patient being made insensible to pain, while all the surrounding parts were abnormally sensitive.

BOTANY.

HISTORY OF THE VEGETABLE KINGDOM.

REV. L. J. TEMPLIN, HUTCHINSON, KANSAS.

[*Concluded.*]

We now approach the period in the world's history that was par excellence the age of plants, viz: the Carboniferous Age; the flora of which has been anticipated in the Devonian Age. In this last we also find anticipation of coal beds in the dark bands colored by carbonaceous matter, which are found between the strata of this age. The vegetation of the Carboniferous Age surpassed in luxuriance and grandeur all that had preceded it; and at least, in the abundance of individual plants it has never since been approached. The land was composed principally of low, marshy islands that were subject to elevation and depression at long and irregular intervals. They were consequently sometimes above the water, and at others the sea would come over and cover them. The climate was tropical in its character, and the atmosphere heavily charged with carbonic acid; on account of the absence of elevated land to cause precipitation it was constantly filled, almost, if not quite, to saturation with moisture. All these furnished conditions favorable for the production of a vegetation, so luxuriant in its abundance and so gigantic in its proportions, that it is doubtful whether the most favored localities in tropical countries of the present day can furnish a parallel. The most important plants of this age of Acrogens may be considered as belonging to five different families. Beginning with the lowest and simplest, the families are Calamites, Sigillarids, Lepidodendrids, Ferns and Conifers. The first three of these are generally classed as Lycopods and Equisetæ; but there are good reasons for considering them as distinct families. Calamites were plants with long, slender, reed-like stems either hollow or containing a pith. These stems were composed of woody structure, and with vascular tissue resembling exogenous gymnosperms. The leaves, which were narrow and pointed, were arranged in whorls around the nodes of the stem. The internodes were fluted or striated, the striæ extending only between the nodes. It is probable the equisetæ belonged here. During the coal age these grew to tree-like proportions, though at the present day they are represented in this country only by the scouring rushes that seldom rise above three feet in height.

Among the most singular and interesting plants of this age, were the Sigillarids. The Sigillaria are found as fossils in flattened trunks, roots and leaves. The trunks of these trees are fluted vertically like the Grecian Doric style of architecture. Each of these flutes has a line of sculpture running down its center varying in shape with the different species, and giving the trees a very ornate appearance. These sculpture-like markings are the scars left by the leaves, being the places where the leaves had been attached to the stem.

These trees grew to the height of 70 or even 100 feet; they probably had few large branches that were covered with long, stiff, pointed leaves. The roots, of which the soil seems to have been filled, had the peculiarity of terminating quite abruptly, as if they had been of the nature of rhizoma. These were probably the largest trees that flourished in the Carboniferous age, their remains having been found four to five feet in diameter, and with an estimated height of 95 to 100 feet. These resembled on one hand palms or cycads, and on the other they were closely allied to the lycopods. Indeed, so strong are the affinities of this for both of these families, that by some naturalists it is classed with the one, and by others it is placed with the other. The Sigillarids were among the most numerous of all the orders that flourished during this age. More than twenty species have been discovered, and extensive beds of coal appear to have been formed almost exclusively of plants belonging to this family. The Lepidodendra were great trees of the Club Moss type that grew to the height of 40 to 60 feet, and with trunks that sometimes attained to three or four feet in diameter. The typical genus, Lepidodendron, which was probably one of the largest of the family, had a bark regularly marked in a rhomboidal pattern resembling the scaly surface of a ganoid fish, from which the genus takes its name, which signifies "scale tree."

These marks which run obliquely around the stem represent the phylotaxis, and give the stem a pleasing and somewhat ornate appearance. The trees were furnished with long, spreading roots, that were calculated to fix them firmly in the soft, boggy soil in which they probably grew. In general appearance these trees resembled the modern Auricaria or Norfolk pine, or a giant club-moss. In fructification they resembled the true club-mosses, but the stem possessed a true pith, and in this respect the genus was raised far above the modern club-mosses and showed decided affinities with endogens. The most abundant family of plants of the coal age, in both individuals and species, were ferns. The *Fern* family constituted about one-third of all the plants of this age in both Europe and America. In the British coal flora, of less than 300 species of plants, 120 were ferns and 45 more were more nearly allied to ferns than to any other known family. The total number of species of plants in the coal measures of America was about 500, not less than 250, or one-half, of which are ferns. These ferns varied in size from the humble, creeping species that trailed on the ground to those of towering trees. In order to enable them to resist the force of the wind the lower part of the trunk was strengthened by having the soft, cellular tissue abundantly penetrated by bundles or buttresses of dense vascular fiber, as tough and elastic as the strongest wood. The last and highest family of vegetation that flourished during the coal measure period, and that contributed toward making up that vast accumulation of vegetable remains, the carbonization of which produced the various beds of coal of that age, is that of Gymnospermous conifers. These did not enter into the composition of coal to a very great extent as compared with the previously mentioned families, their remains being generally in the form of logs, stumps, fruits and leaves, which are most generally embedded in the limestones and sandstones of that age. They were doubtless upland productions, and those that are preserved as fossils were probably driftwood that had been carried down by floods and buried in the alluvial deposits of that time. Though these were without doubt conifers, they bore little resemblance to modern genera and seem to have been very generalized types. They appear to have borne a considerable resemblance to the Auricaria or Norfolk pines of the present day.

Such is a very general outline of the flora of the coal period. A few facts in connection with this flora are worthy of more extended consideration. The first fact that arrests attention is the vast amount of vegetable matter that must have been produced during this age. It has been estimated that it requires not less than eight to twelve feet of vegetation to make one foot of coal, and that a vegetable production of two tons per acre per annum would, when the lighter gases—hydrogen and oxygen—are eliminated, as is always the case in forming coal, produce only one-fourth of an inch of coal in a century. At this rate it would require about 5,000 years to form one foot of coal. Now, in some localities there are beds of 40 to 50 feet of almost pure coal, while in places the aggregate of the different beds reaches 100 and even 150 feet of solid coal. This would indicate an enormous lapse of time, or a luxuriance of vegetation of which we can form no conception. Probably both these causes operated to produce these results.

The next fact to be noticed is the highly differentiated character of the flora of the carboniferous age. We have here in contemporaneous existence the Thallogens of earlier ages, the Acrogens for which this age is specially noted, and the Exogens that were more conspicuous in later times.

Though these all flourished contemporaneously, it has been assumed by some that the more highly developed forms were derived from the more simple by a process of development. But while there has been a general advance in structure of vegetable organisms, there is a lack of evidence of related successional forms that would seem to be essential to sustain such a theory. According to the evolution theory, the various types of plants should have appeared in the order of their complexity of structure: First, the Thallogens, next the Acrogens, next the Endogens, followed still later by the Exogens. And not only should they have appeared in this order of succession, but there should have been gradational forms to show the successive steps by which the lower rose to the higher forms. But such intermediate forms are not forthcoming.

The higher types appear suddenly and without any appearance of progenitors of any earlier types. The assumption that such development must have taken place during the long lapse of time that is supposed to have intervened between the different eras and of which we have no record left in the rocks, is certainly not consistent with the rules of evidence required by scientific reasoning. It is assuming that the theory must be true simply because we do not know it to be untrue. Such a course of reasoning—which is basing our science on our ignorance instead of on our knowledge—can hardly be considered in accordance with the certainty demanded to establish a scientific truth. A third fact concerning the coal flora is, that though the most luxuriant the earth has ever produced, it was in its nature utterly unfit to minister to the wants of herbivorous animals. A few mandibulate insects may have found sustenance in the foliage, bark or wood of some of the vegetable forms of that age, but we have no evidence that any higher animal organisms ever grazed on the verdant plains or browsed in the luxuriant forests of that age specially noted for the abundance of its vegetable productions. The higher animals of this age seem to have been amphibians that probably preyed on the lower forms of animal existence. The orders of plants that prevailed at that time contribute but little to animal sustenance at the present time when herb-eating animals are so extremely abundant.

The Reptilian Age, which succeeded to the carboniferous, was also characterized by the production of extensive beds of coal, indicating a flora that in some degree would rival that of the preceding age.

Extensive coal deposits of this age are found in Eastern Virginia, North Carolina, England, Scotland, India and China. A considerable change, however, had taken place in the vegetable tribes since the coal age proper. The Lepidodendrids, Sigillarids and Calamites of the previous age had measurably or entirely disappeared, and the forest vegetation of the age of reptiles was composed principally of tree ferns, cycads and conifers. The first of these, which had formed so conspicuous a portion of the flora of the previous age, still existed in great numbers, forming near two-fifths of the whole flora. The cycads, which appear here for the first time, were a family of plants allied on one hand to the ferns and on the other to the conifers, and which, in their general appearance, resembled stunted palms. Numerous species of conifers appeared during the earlier periods of this era. The Oölitic and Jurassic periods were remarkable for the abundant gymnospermous forests that existed. As the coal measure periods were remarkable for the prevalence of acrogens, so these were noticeable for the great number and luxuriance of zymnospermous conifers. But when we reach the Cretaceous, the latest period of this era, we find a great advance in the development of vegetable organisms. A more radical change in the flora of the earth never appeared at any other period in the world's history. This period reveals a type of plants not found in any of the older rocks. Angiosperms, both dicotyls and palms, are here found in great abundance. The appearance of a cretaceous forest would have been quite modern compared with anything that had ever appeared before. Among other modern genera might have been seen oak, beech, poplar, walnut, hickory, willow, maple, dogwood, sycamore, sassafras, tulip-tree, laurel, sweet-gum, fig and myrtle. Many of these genera were represented by a considerable number of species that can boast of but one or two at the present time. Of this we find examples in the sassafras, sycamore and others. It thus appears that many of these genera are but the fragments of a much richer flora of an earlier age. When we reach the next age—the Cenozoic or Mammalian—we find the vegetable productions still more resembling those of the present. The genera of dicotyls, palms and grasses, were the same as now, though the species were different. The indications are that a warm climate prevailed far to the north, many of the plants of that age being palms, and among the dicotyls were many, such as the magnolias, that at the present time flourish only in the warm latitudes. In Eocene times numerous species of palms flourished in Europe, while plants of the amentiferous orders, as the oak, beech, hazel, etc., were perhaps quite as abundant as at the present day.

During the Miocene period more than thirty species of palms flourished in Europe, while the country was covered, even as far north as Iceland, Lapland and Spitzbergen with evergreens such as now flourish only in the more southern parts of that continent. Much of the flora of Europe at that time closely resembled the present flora of the United States, as in the plane and buckthorn families. Many of the vegetable productions of America at that time were much the same as now, as the Sequoias or Big Trees and Redwood of California. The mildness of the climate of the higher latitudes was also evidenced by the fact that magnolias, libocedrus and taxodiums that now flourish only in the warmer climates, grew luxuriously in Greenland, also in Northern Europe. We now approach the age of Man—the Quaternary or present age—in which the changes in the vegetable kingdom were more in the introduction of new species of already existing genera, than of new genera.

I have now traced the history of the Vegetable Kingdom from the earliest dawn of its existence of which we have the slightest clew down to the present fully developed and highly differentiated flora of the world We have found that reasons exist for believing that vegetation existed at a much earlier date in the world's history than is shown by any vegetable fossils, the evidences of such existence being found, not in direct vegetable remains, but in certain facts that cannot be accounted for in the present state of knowledge on any other hypothesis. It has been seen that there has been a general upward tendency—a development of plan marking the whole progress of this history. First appeared plants of the most simple character, consisting of simple stems. These, of course, were all marine. Next, the lower cryptogamic plants appeared, followed in order by lower forms of conifers, finally culminating in the highly developed dicotyledonous flora of the present time. I have given some reasons for not accepting the theory that this constant ascension to higher and more complex organisms was the result of "Descent with Modification;" not that I have any objection to evolution in itself; I simply doubt the adequacy or legitimacy of the proofs by which it is sought to be established. The rule of development that has governed in the introduction of higher forms has been by sudden jumps from lower to higher forms, and not by *gradual modifieation.* In most cases of marked advance, all intermediate forms, if they ever existed, appear to have utterly perished, leaving no trace behind. To assume that they have existed and perished is to beg the whole question, and it is disconsonant with the rigid and exact methods that are and should be demanded in all scientific investigation.

GEOLOGY.

GEOLOGICAL FEATURES OF BIBLE LANDS.

PRINCIPAL J. W. DAWSON.

[We find in an Auburn paper an abstract of two of Principal Dawson's lectures at the Theological Seminary in that city upon "The Geological Features of Bible Lands." That upon the special topic, "The Geology of Egypt in Relation to the Hebrew Sojourn," is as follows:—Ed.]

On the blackboard was a section illustrating the geological structure of Egypt, drawn in white chalk. Underneath this was written the following scheme:

Granite and Diorite } (Eozoic?)
Crystalline Stales }
Nubian Sandstone, (Carboniferous),
Nummulitic Limestone.
Later Tertiary.
Alluvial.

The lecturer began by alluding to the sojourn of Israel in Egypt. He took the view that this lasted through the entire period of 430 years, mentioned in the Bible, as opposed to the view that the 430 years began with the departure of Abraham from Ur of the Chaldees. Then, after noticing the importance of the sojourn in Egypt, as a means of training to the chosen people, he entered upon the geographical character of Egypt, the country of the sojourn. He cited the ancient saying that "Egypt is the gift of the Nile." The narrow strip of fertile country broadening out, to the north, into the Delta, is made by the materials brought down and deposited by the great river. Apart from this, Egypt is similar, geographically, to the rest of Northern Africa.

Pointing to the large map of Egypt the lecturer called attention to the Lybian hills on the east, the Nubian hills on the west, and the valley of the Nile between them, and then took up, in order, the scheme on the blackboard. The oldest Egyptian rocks are the granite and diorite, the latter often called basalt by travelers. These are igneous and eruptive in their origin, that is, formed by the action of fire, and pushed up above their former level by eruptions. The lecturer pointed out on the map the distribution of these rocks, and filled up the places assigned to them in the section on the blackboard with little crosses marked in red chalk. He also exhibited specimens and explained the uses made of them by the Egyptians. The great obelisks, the facings of the pyramids, and other like works were made of granite, quarried at Syene, and floated down the Nile. In the geography of the country, also, the granite foundation was important. It caused the cataracts of the Nile, thus forming the limit of Egypt. The succeeding parts of the scheme on the board were treated in the same way.

This analysis was followed by a rapid sketch of the formation of the land of Egypt, first by the upheaval of the igneous rocks, then by the depositing, upon and against these, of the successive sandstone and limestones, and afterward the formation of the later rocks and soil.

All this had much to do with the nature of the Hebrew sojourn, and with their employments and their training while in Egypt. The probable location of the land of Goshen was indicated. When the Israelites were first assigned to it, it was probably being just reclaimed by drainage and irrigation. The marshes to the north afforded pasturage for cattle, and the hills to the south for sheep. These and various other circumstances attending the sojourn, were illustrated by means of the physical characteristics of the country.

The subject of the second lecture was "The Geology of the Sinai Peninsula and its relation to the history of the Exodus." To the maps and diagrams before exhibited were added a larger geological map of the southern part of the peninsula, and cross-sections of the isthmus of Suez and Palestine. The blackboard bore a chart of geological strata, substantially like that presented for Egypt on Thursday evening.

The peninsula of Sinai, said the lecturer, having been for years comparatively unknown, is now accurately known to its whole extent, owing to the recent careful Ordnance Survey under the auspices of the English Society for the exploration of Palestine and other neighboring countries. It is a great triangle, 150 miles at its greatest breadth across the north, and 130 miles long. Its geological formations are identical with those of Egypt, though differently arranged. The mountain region of the lower part is of great physical grandeur, the great rough granite mountains rising to the height of 9,000 feet, and the valley-plains between them being 4,000 feet above the sea Thus in a very small area a wide variety of climate, of scenery and of geological structure is found. The mountains are formed of syenite granite, associated with gneiss and dolorite of the Eozoic ages, and flanked on every side by a belt of Nubian sandstone, rich in ores of copper, iron and manganese. North of this, and forming the great interior table land which reaches almost to the Mediterranean, are formations of cretaceous limestone and of Nummulite limestone of the Eocene period. The other geological formations are a broad strip of later tertiary gypsum series across the north, raised beaches of the post-pliocene on all sides of the peninsula and desert drift of modern formation in various places.

At the time of the exodus of Israel the peninsula was inhabited by three peoples: the Amalekites, nomadic, and pastoral, occupying the arid interior tableland; Egyptian miners and garrisons holding some of the western valleys of the mountains, and the Midianites, miners, and merchantmen, filling the eastern coast along the gulf of Akabah.

The lecturer then went on to speak of the route of the exodus from Egypt, the crossing of the Red Sea, etc. Mustering at Ramses, in their own "Land of Goshen," they were a host of 600,000 armed men, and with women and children must have numbered more than two millions, exclusive of the "mixed multitude," which chose to cast its lot with them. From Ramses across the isthmus of Suez three ways were possible: 1. The maritime road along the coast, between the Mediterranean and the Serbonian marsh, recently maintained by Brugsch-Bey to have been their route; 2. The direct highway across the desert to Canaan, a military road, probably garrisoned by Egyptians; and 3d. The way of the Red Sea. The third is favored alike by probability and the Biblical narrative. They turned then to the southeast, but instead of crossing above Suez, between the gulf and the bitter lakes, were Divinely directed to go further down and encamp by the sea, the mountains shutting them in on all other sides. Pharaoh endeavored to hem them in from the rear, when Divine interposition opened the path through the sea.

Of three places which have been supposed to be the place of the crossing, that just at Suez is in every respect the most probable. This miracle was in the use of natural causes, a strong northeast wind laying bare some one of the ridges of the bottom, as even now it occasionally makes the shallows fordable. That the host in the dead of night and in an awful storm were emboldened to make the passage is itself almost a miracle. Coming out of the sea, they were in what they named the Wilderness of Shur or "the wall," from the great limestone bluff 600 feet high which there confronted them. Turning to the south at the foot of it, they follow along the coast of the Gulf of Suez. Here the wells are few and the water bitter, being impregnated with carbonate of soda. At Marah the water was miraculously made sweet. They next reach the wilderness of Sin, which they so named from its sharp stones, a hot, arid, waterless waste, the worst place of all the wandering. Here the miraculous supply of manna began, and here the great flock of migratory quails was blown to the camp. From the Wilderness of Sin they turned at right angles up the Wady Feiran, a valley rapidly rising to higher and cooler regions. Here occurred their first contact with the inhabitants of the land, the Amalekites, who held the pass against them at Rephidim, a well selected point of great strategic advantages. This the Hebrews reached after two day's march through a waterless country. Here, in their need, the water from the rock was given them. Dislodging the Amalekites after a hard struggle, two days' further march brought them to the great valley plain opposite Mt. Sinai, which the Survey has identified beyond a doubt as the only place which meets the demands of the record. Here in comparative ease and comfort, safe from attack on the rear and with communication open to the friendly Midianites, Israel spent several months; here the Law was given and the Tabernacle set up; here the military organization was perfected which prepared the people to possess the promised land. Hardly a place in the world is so well adapted for the purpose. To the suggested explanation of the awful phenomena, which attended the law-giving, as volcanic, the lecturer said that no volcanic action could have possibly taken place in Sinai during the human period. The phenomena rather resemble the thunder storms which are of such awful force and grandeur in this region. Of the whole narrative of the desert sojourn it was remarked that the exact science of the Survey confirms it at every point, and places it beyond a doubt that Exodus and Numbers are the contemporary journals of Moses, and that he knew every foot of the ground.

THE DAKOTA GROUP.

BY CHAS. H. STERNBERG.

In 1853 Dr. Hayden discovered a number of dicotyledonous plants in a reddish and yellowish sandstone in Nebraska. This formation, lying at the base of the Cretaceous, he called No. 1, or Dakota Group. Later, in connection with Prof. Meek, he discovered the same formation in central Kansas. He found that the plants closely resembled living species of the higher types of our forest trees. Some of these plants were examined by Dr. Newberry, who found among them several genera that were exclusively Cretaceous—and more recent collections made by Profs. Mudge, Lesquereux and the writer, have proved conclusively this group to be the lowest in the Cretaceous. On the eastern margin this deposit lies on the Permian. The other formations of Mesozoic time have been swept away—or, more likely, never existed—and the Permian beds were dry land until the opening of the Cretaceous. The rocks of the Dakota Group consist of strata of red, yellow and brown sandstone, interlaid with beds of various colored clays and lignite. The sandstone is often found in thin, shaly layers. Although the formation has been supposed to be of fresh water origin, the recent discovery of marine shells has proved the contrary. The formation extends from the Gulf of Mexico through Texas, Kansas and Nebraska; touching Iowa, it continues through the British Possessions, and doubtless includes Greenland and the Arctic lands. In Kansas it is about seventy five miles wide, and extends diagonally across the State. Prof. Lesquereux published the first description of the flora of this group; and, later, his magnificent memoir on the Cretaceous Flora has given us a pretty thorough knowledge of the fossil plants. Lesquereux, in addition to his Flora, has published a review of the Cretaceous, in which he describes 26 new species, most of which I was fortunate enough to obtain in the same localities from which he obtained the material for his memoir. I think I am correct in saying that I made the first large collection of fossil plants from the Dakota. They were sent to the Smithsonian and Dr. Newberry—who, so far as I know, has never classified or figured them. They were very fine specimens, and then nearly all were new to science. I showed a number of drawings I had made to Prof. Lesquereux in 1872, who said even then a number of species were new. Since, from his own and Prof. Mudge's collections, he has obtained all the species represented in my collection—though many of his type specimens are much poorer than mine—and I lost the credit due me for my early discoveries and science lost the figured representations of some very fine plants. I must acknowledge that Prof. Lesquereux mentioned this collection in his Flora and gave me full credit for the localities I had discovered and named a number of beautiful plants in my honor. One of the earliest plants to excite general interest was the sassafras; a trilobate leaf with large midribs and well marked nerves. One of the species, *S. mudgii*, resembles the common sassafras. Nearly all the forest trees of to-day are represented in the rich Cretaceous flora. I have discovered in the bluffs near Ft. Harker a number of species of the *aralia*. *A. quinquepartita* has five lobes, margin entire, while *A. saporteanii* has five large lobes with dentate margin—both are very fine species, and allied to our highest families of existing trees. *Aralia tripartita* (or *imperfecta*) is a smaller species with thirteen entire lobes. A number of other species have been described by Lesquereux, showing that this magnificent tree was well represented by numerous species in the Cretaceous forest. The sassafras, as I have said, was the first plant to excite interest. It is represented by a number of species—*S. mirabile* is a large leaf with three lobes, having a wavy and dentate margin; *S. cretaceum* and others are very abundant in the sandstone of Ellsworth county, Kansas. A closely allied genera is *cissites*—in fact, its species have usually gone under the genus *sassafras*. *Cissites Harkerianum* and *obtusum* are very common. The stately plane, poplar, oak, black walnut and many others left their leaves imbedded in the sandstone of the Dakota Group. One magnificent specimen I found near Ft. Harker belongs to the genus *aspidiophyllum* and species *trilobum*. I have found specimens a foot in length and breadth. One peculiarity of the species is, that the midrib is perfoliate—an ear projecting below the stem. Another species with perfoliate midrib is *Protophyllum Sternbergii*—a leaf one foot in length and six inches wide, with undulate margin. The graceful leaves of the *menispermites* and poplar are often found. The texture of the rock is so fine-grained that the midribs, nerves and outline are as finely imprinted as if done in wax. I believe I can claim the honor of being the first to obtain pine cones from this formation.

Dana says in an old manual that they are not found in the cretaceous. One beautiful cone with leaves is described in Lesquereux's Review of the Cretaceous, under the name of *Pinus quenstei*. Among the semi tropical plants is the cinnamon and fig. The common plum is also found. We have, therefore, at the opening of the cretaceous a flora rich in recent genera. Not only do lowly forms appear, but the highest families of our forest trees; each species representing a perfect tree with no known ancestors. How can we reconcile this fact with the theory of evolution, where long ages are required for the perfection of species, and where the geological record should show these transformations, step by step, from lowly forms to the perfect tree. Certainly the records show no such advances in the vegetable kingdom. But as early as the Cretaceous we find as perfect a flora as exists to-day, without even the Trias or Jura to draw from. The Dakota limestone lies on the shales and limestone of the Permian. The formation has been but little explored, and the rich returns from limited areas led us to expect many new species when the rocks are explored. The sandstone is valuable for building purposes. The Post Hospital at Fort Harker is built of thiss tone, and though it has been dismantled, and the wood work carried away, the walls still stand, and the rains of summer, and frosts and storms of winter have been unable to crumble them in ruins. Beds of lignite are found in Ellsworth county that are of great value to the inhabitants. Potters' clay is also found, as well as iron ore, aluminous shale, iron pyrites, and crystalized gypsum. The iron ore is said to be equal to the best Swedish. The soil is rich and produces good crops of corn and wheat. The surface is undulat'ng, and covered with a thick carpet of buffalo grass that protects the soil from denudation. We find near Fort Harker large concretionary masses of fine sandstone. They are valuable for grindstones. Some of them are 20 feet in diameter, and where they rest on soft rock that has been fashioned into rude pillars by the elements, they resemble huge mushrooms. I trust Kansas will soon organize a thorough geological survey. It is too bad that science must wait for private enterprise to develop the rich stores of animal and vegetable remains buried in the rocks of our great State. Already many rich collections have been taken out of the State to Yale College, Philadelphia, and other Eastern museums. Among the marine shells described by Prof. Meek are found *Cressatellina oblonga*, *Arca parallela*, *Yoldia microdonta*, *Cardium Kansensis*, *C. Salineus*, *Turbo mudgiana*, etc.

MEDICINE AND HYGIENE.

THE THERMOGRAPH: ITS EVOLUTION AND DESTINY.

A. WELLINGTON ADAMS, M. D.

[Dr. A. Wellington Adams, of Colorado Springs, has invented an apparatus for measuring the heat of the body for a given or an indefinite length of time, to which apparatus he gives the name of Thermograph. It is a very ingenious contrivance, and it is based upon the principles Breschet advocated. Medical men have long been plodding on with the ordinary medical thermometer, the best of them recording but one application to the body. It must be evident to every one in the medical profession, as well as those out of it, that any instrument that can so record the temperature that the medical man can enter the sick room, day or night, and see what the temperature of the body has been for any hour, half, or quarter hour of the twenty-four, we repeat, it must be evident, that such an instrument must be of incalculable value to mankind. This Thermograph widens the field of the diagnostician and allows him to prognosticate more surely.

There has long been a need for something which would register accurately the rise and fall of temperature during sickness, and the present system is sadly limited by the many imperfections and the very narrow range of its application, and we are glad of this addition to the mechanical appliances of medicine. In dealing with the force, electricity, Dr. Adams found many obstacles; the greatest were the proper condition of the conductive carbon under pressure and the friction of the apparatus, the last by no means being the least. Also, by his studying the principles laid down by Breschet and Becquerel, Pere et Fils, he has succeeded in giving to the world his Thermograph, an instrument which will be a very valuable auxiliary to physiological, therapeutical and pathological investigation. Dr.

Adams in the first part of his article discusses the subject in general, and we will give the remainder in his own words.—R.W.B.]

My researches now remained *in statu quo* for some time, when one day, in the course of conversation with Dr. J. Harry Thompson, of Washington, D. C., he suggested the utilization of the newly discovered property of carbon to vary its conductivity under different degrees of pressure.

I immediately availed myself of this suggestion, developing the instrument as now perfected and illustrated in figs. 4 and 5. This is the thermometer proper

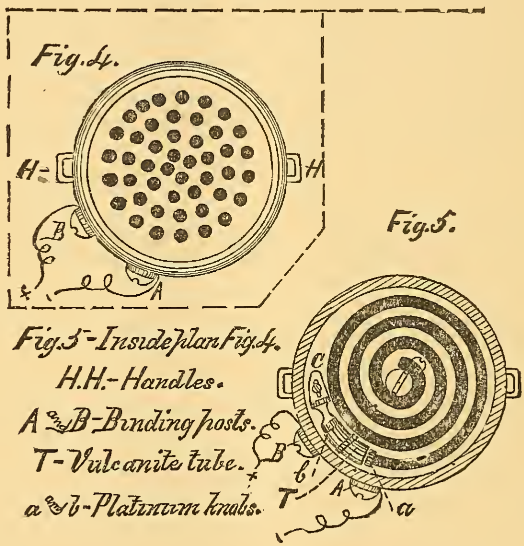


Fig. 5—Inside Plan Fig. 4.
H.H.—Handles.
A & B—Binding posts.
T—Vulcanite tube.
a & b—Platinum knobs.

or responding portion of the instrument, and consists of a spiral spring made of two *lamellæ* of brass and steel respectively, soldered together, the brass occupying the outer side. Of course this spring expands uniformly with equal increments of heat, and the brass, the most expansible of the two metals, will, upon a rise of temperature, give the platinum knob (a), attached to the free end of the spring, a concentric twist. In this way we produce a varying pressure upon the contents of the vulcanite tube (T), against which the platinum knob (a) impinges.

The other end of the substance contained in the hard-rubber tube (T) has for its abutment the platinum knob (b) attached to the hard-rubber bracket (C). The whole, as seen in fig. 4, is inclosed in a perforated German silver case, with rounded edges, and having an external diameter of but 1¼ inches.

The binding-post (A), fig. 4, is in electrical communication with the platinum knob (a), and the binding-post (B) is in electrical communication with the platinum knob (b). When the apparatus is introduced into an electric circuit, by attaching the two poles to the two binding-posts, the current enters through one and emerges at the other, passing in its course through the substance in the vulcanite tube (T). The two little handles (H) (H) are intended as a means of securing the instrument in its proper position in the axilla. The composition used in the vulcanite tube (T) may be either a solid stick of baked lamp black, a series of thin carbon discs with intervening ones of silver, or a powder made of plumbago, gas-carbon and silver, finely divided. After receiving a communication from Thomas A. Edison in regard to this matter, I commenced a series of experiments to determine the most suitable compo-ition for this purpose, and the best results were obtained from the powder already referred to. The salient feature of this instrument is the changing of its electrical resistance with pressure, and the ratio of these changes, moreover, corresponding exactly with the pressure, the latter, in turn, being dependent upon and in unison with the rise and fall of temperature.

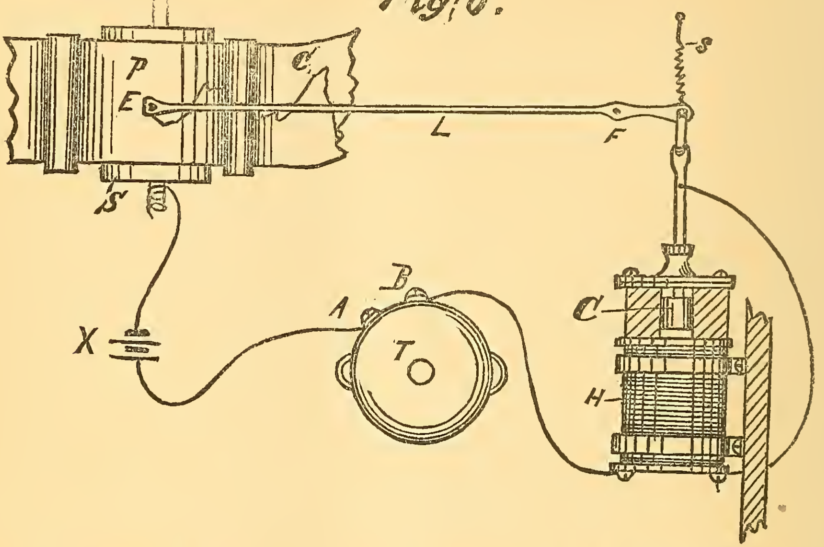
Here, then, was the true solution, for, by subjecting this instrument to varying degrees of temperature, the resistance of the powder would vary in precise accordance with the pressure exerted by the uniform expansion of the spiral spring under equal increments of heat, and consequently a proportionate variation would be produced in the strength of the current. The latter would thus possess all the characteristics of the heat waves, and by its reaction through the medium of some electro-magnetic piece of mechanism yet to be devised, these might be transferred to our movable surface, in the form of a sinuous line, whose rising and falling inflections would give a graphic representation of them.

Now, that I had satisfactorily reduced this portion of the problem, the next in order was the devising that part of the instrument intended for recording such variations as the other branch might be subjected to. This, I assure you, was no easy task, but one requiring a mint of patience and tedious application. For, first—it must be simple; second—there must be established a permanent relationship between the first and second branches of the instrument, in other words, there must exist throughout a strict interdependence; third—in order that the electro-motive force required might be reduced as much as possible, it must be delicate; fourth—to render the latter possible, friction must be practically reduced to a minimum. To carry you through the almost endless and varied experiments necessary in developing means for meeting these indications would be as tiresome as it would be unnecessary. Hence, I shall confine myself to the result only.

If a number of coils of insulated wire be wound around a hollow reel, there is formed what is known to electricians as a *helix*. If this is now placed in an electric circuit and a current passed through its convolutions, it is temporarily constituted a magnet, the two ends forming the poles; so that it may be said to possess all the properties of a permanent magnet during the passage of the current. Moreover, if such a helix, mounted in a vertical position in such a way that an iron rod can be introduced into it from below, be connected with a battery, the iron rod will be at once drawn up into it and be sustained oscillating in its axis, even though the rod may weigh considerable.

The depth the iron rod enters will also depend entirely upon the strength of the current and the amount of resistance offered by the iron rod. This principle is well known in physics as the "axial electro-magnetic force," and in it I found what I sought, namely—a combination of delicacy and strength in the proper proportions. A diagramatical illustration of its application may be seen in fig. 6,

Fig. 6.



where H represents a helix of peculiar construction applied to the purpose in hand; C is a soft iron tube in connection with the short end of the lever (L); P represents the movable surface or strip of paper; F, the fulcrum of the lever, and E its marker or stylus; T, the thermometer proper introduced into the circuit; X, the battery; c, the curve, and S, the brass drum over which the strip of paper (P) moves.

Having comprehended the principles, the action of this combination is obvious. If an electric current passes through the helix (H), the core (C) will be drawn into said helix, carrying with it the short end of the lever (L), to which it is attached. This movement naturally causes the marking end of the lever to make a still longer excursion in the opposite direction. Upon breaking the circuit, the attractive power of the helix is abolished, and the counter-action of the spring (s) returns the lever to its normal position.

The depth to which the core (C) is drawn into the helix (H) being dependent upon the strength of the current passing through the coils of wire, the excursions of the tracer or lever will also be great or small, according as the current is weak or strong.

The lever (L) is delicately made, and its fulcrum provided with jewel mountings. Its short end is connected with the core (C) by means of a universal joint, while its longer end has inserted in it a silver stylus reaching to the surface of the traveling paper. The latter moves over a brass drum forming a portion of the circuit. The strip of paper passing over the brass cylinder, having been saturated with a solution of chloride of sodium, pyrogallic acid, and ferrocyanide of potassium, the instrument is complete.

When this combination is in operation, a current of electricity will pass from one pole of the battery to the binding-post (A) of the thermometer proper, through the substance in the vulcanite tube to emerge at binding-post (B); thence through the helix to the lever, along this to the silver stylus; thence through the moistened paper and brass cylinder to the other pole of the battery—thus completing the circuit. Upon the application of varying degrees of heat to the thermometer proper, the resistance the current meets with during its course will be varied in precise accordance with the various changes of temperature. This waxing and waning current will now pass through the helix, and by the latter's peculiar action produce to and fro motions in the lever, passing, at the same time, through the lever and chemically prepared paper, and producing as it passes a double chemical decomposition upon the paper; one of which decompositions renders the development of friction, during the movements of the lever, so slight as to be imperceptible; the second decomposition producing a change in color upon the paper, corresponding to the movements of the stylus, and affecting no larger surface than it covers, thus obviating the additional friction accompanying the use of an ordinary marker.

From this description you will understand that the lever is moved backward and forward by a difference in the attractive power exerted by the helix, this in turn being dependent upon the strength of the current, which has already passed through the thermometer proper, and there been moulded into electric waves corresponding to the heat waves; the motion of the lever being facilitated by the lubricating action of the current, as the result of one of the chemical decompositions during its passage through the chemically moistened paper; while the other decomposition causes a discoloration, and thus produces a mark corresponding in outline to the movements of the lever. This mark will, therefore, form an irregular line, whose sinuosities will give a graphic representation of the heat variations. This apparatus is extremely sensitive and can be made to record 1-100 of a degree.

Now, after marking upon our strip of paper the minimum and maximum points representing respectively 90° and 110°, it becomes a very easy matter to determine the degree of heat represented by any point lying within this range. This is accomplished by dividing the intervening space into any number of equal parts, when any one of these divisions will represent a degree or any part of a degree, according to the number of divisions. These horizontal lines may be placed at such distances from each other as to represent 1-10 of a degree. Having provided the traveling paper with a uniform speed, it also becomes an easy matter to determine the time represented by any given distance upon its surface; for, supposing a certain amount of paper passes a given point in the instrument in one hour, to determine the amount passing the same point in five minutes, it is only necessary to draw vertical lines dividing this distance into twelve equal parts, each one of these will then represent five minutes.

After determining upon the principles it became very easy to work up the details that would place the instrument in a convenient form for manufacture and use. These may be seen, as applied, in figs. 7 and 8. Fig. 7 is a front elevation of the complete thermograph.

Fig: 7.

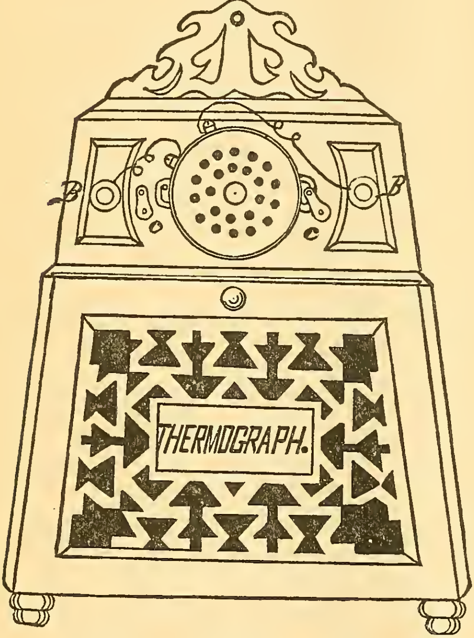
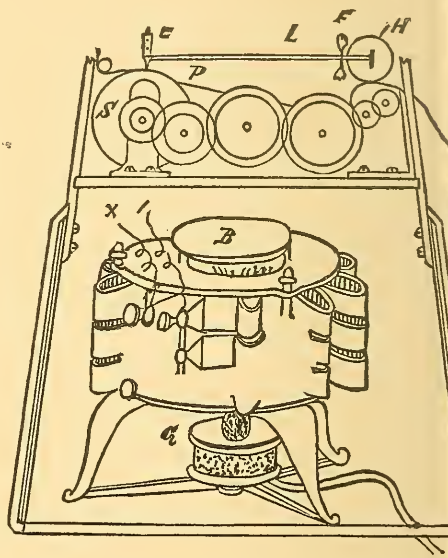


Fig: 8.



It consists of a cast-iron case having two departments, one for the recording mechanism and actuating clock movement, the other for the battery. In the upper part of the front there is a circular depression for the reception of the thermometer proper or perceiving portion of the instrument when not in use.

This is held in place by means of two little catches, one on either side, as seen in the figure. On both sides of this are the binding posts for the reception of the wires leading from the thermometer proper, when the latter is in position in the axilla. The open work in the lower portion is intended for the ingress of air and egress of gases. Fig. 8 is an interior elevation with the front removed; above is seen the recording mechanism, and below the thermo-electric battery. This form of battery gives a continuous and unvarying current, requires no cleaning or recharging, and costs but little to run, hence it is the most available source from which to derive the current; the heat for operating it may be supplied by either an alcohol lamp or gas-burner. Not only is it possible with this instrument to procure a continuous curve denoting the constant febrile condition of a subject, but, with the addition of certain accessories now in process of construction, and as suggested by Prof. Mayer, of the University of Technology, Hoboken, and Dr. Toner, of Washington, we may be able to procure, on the same strip of paper, at the same time and under similar conditions, a sphygmographic and a respiratory curve; thus enabling pathologists, therapeutists, physiologists, and, in fact, general practitioners, to study the inter-relationship of these three cardinal symptoms under various modifying circumstances. These are the *possibilities*, but when we drift into the *probabilities*, we see in prospective the addition of that which will also furnish a moisture curve. Of the advantages of the graphic method as applied to medicine, I need hardly speak. It already promises for medicine what it has accomplished in physics.

Every physicist adores such familiar names as Leon Scott and Dr. Clarence Blake, to whom we are indebted for the application of the graphic method to the science of acoustics, through the medium of the phonautographs invented by themselves.

To the experimental therapeutist this instrument is of incalculable value, as affording a means of determining the precise character of the temperature changes under the administration of various therapeutic agents in different sized doses and modes of exhibition.

The experimental physiologist will find in it that which will materially facilitate accurate observation in his field. And the advantages accruing from its application in pathological investigations, and the possibility of thus elucidating hitherto obscure phenomena, must be patent to every one. An instrument of so much value as an aid to observations in these three important branches of scientific medicine, needs no further lauding; but I cannot draw my paper to a close without setting forth the mode of application and the advantages attending its use in every day practice.

Take, for example, a suspected case of typhoid fever, experience and experimentation with the thermograph having already revealed a characteristic *minor* wave curve for typhoid fever. The physician is summoned. Upon arriving he applies his thermograph in the following manner: First, the perceiving portion, as seen in fig. 4, is fastened in the axilla by means of two elastic bands attached to the handles H H, one passing around the trunk, the other over the shoulder. Next, two fine and flexible silk covered wires are led from the binding-posts A B, fig. 4, to the binding posts B B, of fig. 7, the latter having been previously placed upon a stand at the head of the patient's bed.

These wires, of course, are of sufficient length to admit of any degree of motion on the part of the patient without interfering with the position of the recorder. The instrument will now be ready for use, and, upon starting the battery, it will continue in operation for any desired number of days, with little or no attention outside of winding and replenishing with new rolls of paper.

The first benefit to be derived from its use in such a case, consists in the ability to determine upon a diagnosis much earlier than would ordinarily be possible; second—the physician is furnished with a permanent record of the condition of his patient from hour to hour and day to day; third—the slightest modification or variation by reason of an exposure, the exhibition of prescribed remedies at given hours, or the ingestion of prescribed food during the day, will be revealed to the physician when he makes his evening visit, thus affording him from time to time, a more definite idea of the immediate effect, good or bad, of his treatment; fourth—it will give warning of danger from collapse during the crisis before it could be detected in any other way; fifth—the physician is provided with a means of leaving more definite directions with the attendant or nurse, e. g. he will be able to say that "should the curve assume such or such a character, or the line rise to this or that point, you may discontinue this, that, or the other remedy, and proceed to exhibit *this*, according to the directions; or, should such and such a thing take place, it will indicate an emergency calling for this, that, or the other measure."

The science of meteorology, also, will find in the thermograph an instrument it has long felt the need of. Never before has there been invented an instrument capable of furnishing a curve representing the constant temperature of the atmosphere. To be sure, there are two or three instruments in the possession of the United States Weather Department at Washington, constructed upon an entirely different principle, which automatically produce a continuous curve, but the latter is only by reason of the velocity with which the cylinder revolves; besides, they are of an exceedingly complicated nature, cumbersome, and *very* expensive.

The simplicity and inexpensiveness (it will cost about $50) of the thermograph, place it within the reach of almost every physician, and will enable the United States Weather Department to furnish one or more of them to every one of its sub-stations.

This, gentlemen, is the instrument I have chosen to dignify with the title of *Thermograph*, and which I have lately placed in the hands of Aloe & Hernstein to manufacture for the use of the medical profession.

With its introduction, I predict the dawn of a new era in medicine, marked by progress equal to that accompanying the introduction of the sphygmograph, myograph, cardiograph, and other important instruments of a similar character.

—*Rocky Mountain Medical Review.*

FOR CHILBLAINS.

The following formula for Dr. Valentine Mott's Remedy is given in the "Proceedings of the Medical Society in the County of Kings:"

℞ Beef's gall	4	ounces.
Ol. terebinth	4	"
Spts. vini rect. 90 per cent.	1½	"
Tinct. opii.	1	"

Another formula for the same affection is:

℞ Beef brine.	1 pint.
Potassæ nitratis	2 drachms.
Aquæ ammoniæ	3 ounces.

GEOGRAPHICAL.

THE HOWGATE EXPEDITION TO LADY FRANKLIN BAY.

[The following Report of the Board appointed to consider Captain Howgate's plan and preparations for his second Polar Expedition, shows what extreme care was taken in the selection of a proper vessel and in all the details connected with the fitting out of the expedition.—EDITOR.]

A Board of Officers and men of experience in Arctic matters was convened at the Signal office in Washington D. C., May 27, 1880, by direction of the chief Signal Officer, to consider and report of a "Memorandum of plan of Arctic work," submitted by Captain Howgate in connection with the proposed expedition to Lady Franklin Bay.

The Board reported as follows:

1. With respect to the provisions and fuel for the steamer *Gulnare*, and the advisability of having a surgeon for its return trip, the Board is of the opinion that these matters should be left to the discretion of the Navy Department.

2. Mr. H. C. Chester, a member of the Board, who accompanied the *Polaris* Expedition, and who is now superintending the fitting out of the *Gulnare*, states that it is the best adapted for the purposes designed of any vessel that has entered the Arctic seas.

3. The permanent party to remain at the station near Lady Franklin Bay, to be composed of three commissioned officers and twenty-five men, appears sufficiently large. These will be available for scientific work—three officers, one surgeon, one astronomer, one photographer, and three sergeants of the Signal Corps. A portion of the scientific work to be performed has already been provided for by a previous Board.

4. It is understood by the Board that the discovery and development of new whaling grounds will be incidental to the duties of exploration.

5. There is little reason to anticipate any danger to the permanent station; it is to be provisioned for two years or more. The *Polaris* left abundant stores on the opposite side of the channel, distant from Lady Franklin Bay some thirty or thirty-five miles; also the English Expedition, under Nares, left at Cape Hawk "a large quantity of biscuit."

6. The providing for the safety of sledge and traveling parties will, of necessity, have to be left to the discretion of the officer commanding the expedition. Tents are the only shelter for such parties that can well be transported, but such parties will build igloes, or snow houses, when the materials are at hand.

7. The means of transportation proposed—two whale boats, one steam yawl, six dog sledges, and thirty dogs—are considered ample.

8. The detailing of selected enlisted men for the body of the expedition promises many advantages. Of the men already selected, two have been sea-

men, four are accustomed to the use of the oar, one is a fair carpenter, and two are rough carpenters.

9. The members of the Board having had Arctic experience in the latitude of Lady Franklin Bay consider the quarters provided sufficient in capacity and comfort for the party proposed.

10. The clothing suggested appears to be sufficient in quantity and adapted to the climate.

11. The arrangements for heating and cooking appear adequate.

An abundant supply of oil for lighting for two years has been provided.

The surgeon of the expedition states that his requisition for medical stores will be sufficient for any anticipated emergency.

For scientific investigation more spare instruments should, if practicable, be provided.

QUARTERS.—A frame house, 21 by 65 inside size, with double walls, 18 inches apart, is ready for shipment, and will accommodate the whole party comfortably. This house is built after the model of those used in the Hudson Bay Territory by the company, and is, therefore, assumed to be suitable, both as to size, style and comfort.

For moving parties four wall tents with flies, and twelve A tents complete, have been provided, and will be sufficient.

CLOTHING.—Boots, stockings, mittens, sheepskins for clothing, and sleeping bags in sufficient quantity for three years' supply is on hand ready for shipment. There is still needed a supply of overcoats, blankets and drawers, which can be supplied by the Quartermaster's Department within ten days from the date of requisition.

Twenty suits of sealskin or deerskin will be obtained at Rigolette, on the coast of Labrador, in accordance with previous arrangements. If for any cause the clothing is not ready at that point, it can be obtained at Disco, and is not absolutely essential, although it should be procured if practicable.

MEANS OF TRANSPORTATION.—Two (2) whale boats, (to be got on the N. E. coast). One (1) steam yawl, (now ready). Four dog sledges, (now ready at Rigolette, Labrador). Thirty (30) dogs, expected to be ready at Rigolette, Labrador; if not ready, can be got on the Greenland coast, at Proven or Upernavik).

FOOD.—Two years' supply, as per list, already in the hands of the Secretary of War, and which, having been prepared with the assistance of Captain Wm. Kennedy, Dr. John Rae, and other Arctic explorers, is believed to be complete.

The pemmican, which is the only item not procurable from the Commissary Department, is now in Washington, ready for shipment.

Requisitions for all the other provisions have already been submitted to the Secretary of War for approval.

FUEL AND HEATING.—Coal to be used as fuel, and the supply to be obtained on the spot, from the vein discovered by the English expedition, necessary tools for getting out the coal have been provided, under the advice of the manager of some Pennsylvania coal mines. The vein of coal must be critically examined before the vessel leaves the party, in order that a proper supply may be left from the ship's stores if that on shore is impracticable.

Four stoves, two cooking and two heating, have been secured, and with all their necessary furniture, are packed ready for shipment.

LIGHT.—A large supply of lamps and lanterns of various sizes and kinds have been secured, with sufficient carbon-oil to serve for one full year.

A full list of medicines, with surgical and medical apparatus, has been prepared by the surgeon, and is ready to submit for the approval of the Secretary of War.

Reading matter has been contributed in abundance, and is ready for shipment

Surveying apparatus and marine chronometers on hand. Other apparatus can be ready within ten days.

ORDNANCE STORES.—Six (6) Springfield rifles. Six (6) shot-guns. Six (6) revolvers, with necessary ammunition, and 1,000 pounds of blasting powder have been secured, and are ready for shipment.

Miscellaneous apparatus includes signaling outfit complete for four stations, including candle-bombs, heliographs, etc., etc. Eight (8) telephones. Four (4) call bells. Ten (10) miles No. 15 wire, plain. Four (4) sets telegraph instruments. Thirty (30) cells battery, Eagles. 500 pounds blue-stone and such other small items as are needed to put up two or more telegraph offices.

Vessel to leave Washington not later than June 1st and to proceed under sail to St. Johns, N. F., where she will stop for coal, ice pilot, and any other items of supplies that may be needed.

From St. Johns she will go to Rigolette, where the sledges, dogs, and the twenty suits of clothing will be taken on board. It is probable that two half breed hunters will be ready here to join the party, as partial arrangements for their services were made last year.

From Rigolette the vessel will proceed to Disco, using steam only when necessary.

At Disco the coal bunkers will be refilled, either from the Danish stores or from the supply left by the *Polaris*, if that has not been consumed. The vessel should leave Disco with her coal bunkers filled, and as much more coal stowed on board as can be provided for.

From Disco to Lady Franklin Bay the only stops other than those caused by ice or other causes incident to navigation will be at the several Danish settlements of Proven, Uppernavik and Tessieusak, for dogs and dog food, if these have not previously been secured. Arriving at Lady Franklin Bay the permanent party will be landed and the cargo discharged with as little delay as practicable, as near the mouth of Watercourse Creek and the coal vein as it is practicable for the vessel to get.

As before stated, the quality and accessibility of the coal-vein will be examined, and if found satisfactory, it will not be necessary to leave any of the vessel's coal; otherwise, a year's supply—say 60 tons, will be left.

The *Gulnare* should not leave the station at Lady Franklin Bay until at least one year's supply of fuel has been obtained from the coal mine in that vicinity, or if this cannot be obtained, at least sixty (60) tons should be left from the ship's supply.

In any event the *Gulnare* should not be permitted to proceed on its return trip until the officers of the ship and of the party shall have certified in writing as to the suitability and fitness of the supplies and the apparent safety of the station, a copy of which certificate shall be brought back in the vessel.

It is also thought that some point should be selected during the ship's journey northward, where supplies should be left in 1882, if a relief ship could not by that year reach Lady Franklin Bay.

The Board is of the opinion that there should not be an increase in the arms now provided.

If all the arrangements of the plan proposed by Capt. Howgate be faithfully carried out, it would appear that proper precautions and safeguards have been provided to secure the safety of the Arctic Expedition, and to promise reasonable success in the attainment of the objects for which the expedition was organized.

Special suggestions in writing by Mr. Bryan, of this Board, and by Sergt. O. T. Sherman, of the Signal Corps, accompany these proceedings.

J. P. STORY. H. C. CHESTER.
A. W. GREELY. OCTAVE PAVY.
R. W. D. BRYAN.

THE HOWGATE EXPEDITION TO LADY FRANKLIN BAY.

OUTLINE OF SCIENTIFIC WORK.

The following plan for astronomical, metereological, and magnetic work at Lady Franklin Bay and other stations in high latitudes, was prepared by Capt. Howgate, Lieut. Story and Professor Abbe, of the Signal Office, in compliance with official instructions from the Department:

I.—MAGNETIC WORK AT FIXED STATIONS.—The outfit necessary for this work is considered to be as follows:

1. The Unifilar Declinometer, or the complete Magnetometer, as made by Fauth & Co., Washington, D. C., No. 70 of their catalogue, and costs about $400. This should have a set of very light needles, as well as the ordinary heavy ones, and is to be used for absolute and differential observations of declination.

2. A Kew Dip Circle to be used for dip and total intensity. It should be compared with similar observations made at Washington, at the Coast Survey

Magnetic Observatory, before starting on the expedition, and also after the return.

3. A Ship's Chronometer very accurately rated in Mean Time. With these instruments, the declination dip and total intensity should be determined on the 1st and 15th of each month.

The differential observations of declination are to be made with the Declinometer every day, three times a day, namely, at 7 a. m., 3 p. m., and 11 p. m., Washington time, and are to be made by taking readings at the first second of every minute, for fifteen minutes, namely from 7 a. m. to 7:15 a. m; 3 p. m. to 3:15 p. m.; 11 p. m. to 11:15 p. m.

By this means there will be secured observations simultaneously with the Signal Service Meteorological observations, and also simultaneously with the magnetic observations made at the observatories that pursue the Göttingen plan. By these means, also, data will be obtained for showing the rapid fluctuations to which needles are subject when an auroral disturbance is taking place.

The term days will be the 1st and 15th of each month, on which days, besides the fifteen minutes' observations previously provided for, there will be made a special set of readings of the Declinometer, at the beginning of each five minutes throughout the entire day, or if this be not possible, then, at least, in groups of two hours and fifteen minutes, viz.: from 6:15 a. m. to 8:15 a. m.; 2 p. m. to 4:15 p. m.; 10 p. m. to 12:15 a. m., Washington time.

II.—The Magnetic Observations at Temporary Stations By Traveling Parties.—The outfit for this class of work will be as follows for each party:

1. Cassella Astronomical Theodolite, as made by Fauth & Co., No. 60 of catalogue, which is considered decidedly preferable to the English make, it having 3-inch circles, and costing $150 with its stand. This instrument can be used for determination of latitude, time, longitude, azimuth and magnetic declination.

2. Kew Dip Circle, small size, to be used for determination of magnetic dip and intensity.

3. Two Pocket Chronometers, kept accurately rated on mean time.

With these instruments the absolute dip and intensity should be determined at every convenient stopping place, and if the party stays long at any station, these elements should be determined each day, and especially at 7 a. m., 3 p. m. and 11 p. m., Washington time, as before directed for the permanent station. The term day observations should be also kept up by the traveling parties, if they happen to be at convenient stations on the 1st and 15th of the month.

Observers will have to be especially instructed in the use of the instruments. The best works of reference are:

Riddell's Magnetic Instructions, London, 1844. Admiralty Manual of Scientific Inquiry, 1871. Admiralty Arctic Manual, 1875. Walker's Terrestrial and Cosmical Magnetism, 1866. Coast Survey Special Instructions.

The form for records may be those given by Riddell, with such modifications as the modern construction of magnetic instruments may demand.

III.—METEOROLOGICAL OBSERVATIONS.—These should be made at least three times daily, at the exact hours of simultaneous observations, 7 a. m., 3 p. m., and 11 p. m., Washington time; and, unless absolutely impossible intermediate observations should be made every two or four hours, the complete series being at 1, 3, 5, 7, 9 and 11 a. m, and 1 3, 5, 7, 9 and 11 p. m. In case that self-registering apparatus is suyplied, the personal observations of those items that are so recorded need be made only at 7 a. m., 3 p. m. and 11 p. m. The thermometers and barometers should be of superior quality, and in general the instruments and methods of instruction embodied in the Instructions to Observer Sergeants of the Signal Corps should be followed. The outfit should be that of a first-class Signal Service Station, to which should be added the following supplementary instruments:

1. Self-Recording Barometer. 2. Self-Recording Thermometers. Regnault's Dew Point Apparatus. 4. Vacuum Solar Radiation Thermometers. 5. Hick's Terrestial Radiation Thermometors. 6. Heiss' Apparatus for Convergence of Auroral Beams. 7. A number of small india rubber balloons and apparatus for filling them, for ascertaining air currents, heights of clouds, etc.

Special instructions for the use of these instruments are scarcely necessary, on account of their simplicity; but, in order to call attention to many minor points, the observer should be furnished with extra copies of the following works:

Signal Service Instructions. Admiralty Manual of Scientific Inquiry. Admiralty Arctic Manual. Instructions to the Florence Expedition. Pickering's Physical Manipulation. Kohlransch's Physical Measurements. Everett's Translation of Deschanel's Natural Philosophy. Loomis' Meteorology. Buchans' Meteorology. Kaemtz' Meteorology.

Special attention is called to the importance of accurate observations at every station of the minute details of auroral phenomena and their changes, (see Stoke in the Arctic Manual, page 19,) which should be recorded carefully by diagrams and otherwise, together with the hour, minute and second of the phenomena.

IV.—ASTRONOMICAL OBSERVATIONS.—The only astronomical observations recommended as imperative are those for determining latitude, longitude and time. Such observations must be made every day at sea, and when traveling. The position of the central station must be determined by observations made at every favorable opportunity, until there have been accumulated at least ten independent determinations of latitude and longitude, so that the mean of all may be reasonably accurate. The determination of the errors of the chronometers must be made whenever practicable and the resulting corrections immediately deduced, so that the meteorological and magnetic observers may be able to maintain strict simultaneity in their observations.

As in all the physical and astronomical observations to be made, the same chronometers must be used, and as these latter are most conveniently kept on Greenwich time, it is recommended that all records and daily reckonings should, without exception, be kept on Greenwich mean time; that is to say, in the corrected chronometer time.

It will thus happen that the simultaneous S. A. M. observations will be made as follows: 7 *h.* 0 *m.* 0 *s.* A. M., Washington time; 12 *h.* 8 *m.* 12.09 *s.* P. M., Greenwich time; 12 *h.* 47 *m.* 58.33 *s.* P. M., Gōttingen time. The only apparatus recommended as outfit for parties is as follows:

I.—For Traveling Parties; for each Party: 1. Pistar & Martin's Prismatic Circle, which is considered preferable to the sextant, as it measures larger angles, which are oftentimes imperatively needed. The instruments should be constructed with special reference to use at very low temperatures.

2. Mercurial, or Artificial Horizon. 3. Two Pocket Chronometers for central station.

1st. The Cassella Astronomical Theodolite, as made by Fauth, as before enumerated under the head of "Magnetic Work." If this cannot be furnished, then the astronomical transit, capable of being used in any meridian, should be furnished; but this is more cumbersome to be set up, and is not recommended. Either instrument should be especially constructed for use at very low temperatures.

2d. Pistar's & Martin's Prismatic Circle, or if not possible, the Sextant constructed by Fauth, No. 73 of this catalogue, price, $110.

3d. The Artificial Horizons.

4th. Four Box Chronometers.

With these pieces of apparatus it is believed that a skillful observer can determine his position with all needed accuracy. The instructions to be followed in the use of these instruments are to be found in Chauvenet's Practical Astronomy, Nautical Almanac (U. S.), Bowditch's 5-figure Logarithm Tables.

In the determination of the errors of sextants and circles, reference should be made to the Memoir by Harkness, in the U. S. Naval Observation for 1869, Appendix I, page 51.

On the use of the portable Transit, the Zenith Telescope, etc., if provided, see Hilgard and others, in the Coast Survey volumes of observations.

The only purely astronomical work to which it is recommended that special attention be given will consist in observing the phenomena of shooting stars.

In this class of work the principal point is the determination of the radiating point for each group of shooting stars that may be seen, for which purpose the observer needs to be supplied with a number of the blank charts of stars, prepared by Prof. H. A. Newton, or with an equivalent planisphere.

EXTRA OBSERVATIONS. It is considered that the following important subjects should be recommended to the observer's attention, viz:

1. Magnetic Earth Currents. (See Nipher on Earth Currents, etc.)
2. Tides. (Earthquakes and earth tremors of the feeblest kind.)
3. Pendulum Experiments.
4. Atmospheric Electricity.

5. Polarization of the Light of the Atmosphere.

6. Spectroscopical observations of the Aurora and Shooting Stars.

7. Soundings to determine depths of Sea and Channel.

8. Temperature of the Sea Water.

9. Density of the Sea Water.

10. Thickness of the Sea Ice, the Ice Floes and the Icebergs.

11. The preservation of specimens of air in hermetically sealed flasks for future analysis at home.

12. The melting of large quantities of freshly fallen snow, and preservation of the resulting atmospheric and meteoric dust for future microscopical examination.

13. Triangulation and charting of coast lines in the immediate vicinity of the station, the location of mountains, etc., for which a simple plane table might be provided, and a tape line for measuring base lines.

Complement of Men.—It is recommended that a chief observer and four assistant observers be detailed to carry out the astronomical and meteorological and magnetic observations herein provided for, and such miscellaneous work as they are able to attend to.

The chief should be especially familiar with the astronomical and magnetic work, and be able to instruct observers in their duties.

ASTRONOMY.

ASTRONOMICAL NOTES FOR MARCH, 1881.

BY W. W. ALEXANDER, KANSAS CITY, MO.

The sun during this month will appear to be moving north at a very fast rate, the daily rate being about 0.7 of its own diameter. On the 20th, at 5 h. a. m., its center passes the equator and also enters the first sign of the zodiac, and spring commences. Mercury, for the first and second days, will show in the west for a few minutes after sunset. On the 11th it will be in conjunction with the sun, after which it will rise before the sun and cannot be seen before the end of the month.

Venus, during this month, shines with great brilliancy in the western sky for about three hours after sunset. It attains its maximum brilliancy on the 27th, after which it will gradually approach the sun, still increasing in apparent size, but decreasing in brilliancy. Its apparent diameter on the 1st is 26″, on the 31st

41″. It is in conjunction with Saturn on the 1st, being north of that planet 5° 29″.

Mars will show for a short time before sunrise in the southeast, but being quite small is hard to find.

Jupiter will still adorn the western sky after sunset. It is gradually approaching Saturn, but will not be in conjunction with it during this month.

Saturn sets a short time after Jupiter; its rings are opening out to view, but it is too near the sun to be observed to advantage.

Uranus is favorably situated for observation, being in the constellation Leo, the Lion. It passes the meridian on the 4th, at midnight.

Neptune on the 22d will be 7° 9′ south of Venus.

The Moon, on the evening of the 3d, will approach very near to Venus, being within less than its own diameter of that planet at the time of its setting.

Position of the Constellations on the 14th, at 6 h. 30 m. in the Evening.

Auriga, the Charioteer, occupies the zenith. In this constellation is situated the bright star Capella, now a short distance northwest of the zenith.

The Milky Way spans the celestial vault like an arch of nebulous light, resting on the horizon in the north northwest and south southeast, and passes through the zenith.

Cygnus, the Swan, is sinking below the horizon where the Milky Way rests upon it in the north northwest. It has nearly disappeared from view. Following the Milky Way we come to Cepheus, the King, and then to Cassiopea, the Lady, in her chair. Next come Perseus and Auriga in the zenith. Continuing in the same path toward the south southeast, we will touch the eastern edge of Taurus, the Bull. It may be recognized by the Pleiades, or Seven Stars, as the group is commonly called. There are only six stars in the group visible to ordinary eyes. An eye which is good enough to see seven will be likely to see four others—eleven in all. A telescope of moderate power will show from fifty to sixty. Another group in this constellation is the Hyades, the principal stars of which are in the form of the letter V, one part of the V being formed by Aldebaran, a red star of nearly the first magnitude.

Gemini, the Twins, lies east of Taurus, across the Milky Way. The brightest stars in this constellation are Castor and Pollux. Castor, the most northern and western of the two, is a double star when viewed with a telescope of moderate power.

Cancer, the Crab, lies east of Gemini. It contains no bright star. The only remarkable object within its confines is Præsepe, a group of stars too faint to be seen singly with the naked eye, and only appears as a spot of milky light.

Keeping on along the milky way toward the south southeast, we will pass along the western edge of Canis Minor and through Monoceros and by the eastern edge of Canis Major, which contains Sirius, the brightest star in the heavens. A number of bright stars south and southeast of Sirius belong to this constellation, making it one of great brilliancy.

THE LICK OBSERVATORY TELESCOPE.

The trustees of the Lick Observatory have finally closed the contract for the optical part of their great telescope. There has been considerable doubt whether a refractor or an enormous reflector would be selected, but the decision is in favor of the former. The object glass is to be three feet in diameter, and the Clarks of Cambridge, Mass., are to make it for $50,000. The mounting of the instrument is not yet provided for. Proposals will be obtained from the principal instrument makers of Europe and this country. Probably the mechanical part of the instrument will cost as much as the optical. It may be three years before the telescope is finished. If the instrument proves successful, it will be the most efficient ever pointed at the heavens. Its power will exceed that of the Pulkowa glass by forty-four per centum, and it will be almost twice as powerful as the great telescope at Washington, which at present is the best of its kind.—*Scientific American.*

METEOROLOGY.

CLOUDS—LIGHTNING.

PROF. S. A. MAXWELL.

Clouds and lightning stand in relation to one another as cause and effect, therefore, in the proper consideration of the former subject, more or less mention of the latter must also be made.

"Lightning consists of an electrical discharge between cloud and cloud, or between a cloud and the earth, and sometimes between the upper and lower parts of the same cloud." Such is the definition given by Prof. Henry to that wonderful electrical phenomenon, so often accompanying storms in the temperate and torrid regions of the earth—a phenomenon of such common occurrence as scarcely to need a definition, and yet so peculiar in its nature and action as to remain, even yet, to a certain extent unknown and unexplained. The discovery of the identity of lightning and atmospheric electricity was due to the genius of Franklin, who, more than any other philosopher of the eighteenth century, contributed valuable additions to science by his tireless researches and novel experiments.

The electric spark in its passage through the air may be viewed under different conditions: hence arise those different names,—sheet-lightning, heat-lightning, chain-lightning, etc. If the spark is hidden by clouds, as it generally is during a storm, and a part of its light is reflected from the under side of the cloud, people call it sheet lightning. If seen during the serenity of a warm summer night, gilding the corrugated edges of a far-distant storm-cloud, or flashing from an apparently cloudless horizon, with gleams like the aurora—then, people say it is heat-lightning. Lastly, if it breaks suddenly from the base of the threatening cloud, and spans instantaneously with a jagged chain of blinding fire the intervening space to the earth, then, it is denominated chain-lightning. Now, in truth, these three forms of lightning are identical, the diverse appearances which they present being due entirely to external conditions.

Sometimes there occurs a form known as arborescent lightning. This is produced when a spark of electricity passing along the horizontal base of a cloud suddenly divides into several trunks, and these, sub-dividing again and again, produce the representation of a tree, with limbs interlacing one another in a network of fire. This form in its perfection is rarely witnessed. On the evening of August 6, 1870, a most magnificent exhibition of this species of lightning occurred. Hundreds of glittering sparks, originating from one, darted along the base of the storm-cloud, after the rain had passed. The aggregate length of the different ramifications of this single flash must have exceeded 150 miles! What is remarkable about this form of lightning is its comparatively slow movement. The duration of the flash on this occasion amounted to as much as two seconds; and, according to Arago, a flash of lightning requires only 1-288,000 part of a second to pass from a cloud to the earth, supposing the distance to be a mile. Another remarkable example of arborescent lightning occurred in June, 1870. In this instance, the storm was coming up from the west, though the "fan-cloud" had already extended far to the east. Suddenly, far in the west, almost down to the horizon, in fact, the electricity originated, and, passing eastward along the cloud in numerous diverging and ramifying lines, finally terminated in the outlying borders of the cloud, not less than *sixty miles* from its starting point. The extent of this flash was greater than any other on record, so far as I know, being nearly five times greater than any noted by either Arago or Flammarion. The rumbling of the thunder continued in the west for fully *four minutes* after the flash, and no subsequent flash occurring, the sound must have been the result of this most remarkable discharge. The flash must have extended at least fifteen miles to the east of the point of observation, and forty-eight to the west of it. No rain was falling at the time, and none fell until an hour afterward, and then but very little. This was the finest exhibition of Nature's fireworks that I have ever witnessed: the surpassing brilliancy of the flash and the prolonged detonations of the thunder combined to produce an effect of astonishing beauty and grandeur.

I will not speak of the so-called *globular* lightning, as I believe it never appeared in reality, but only as the product of an excited imagination; nor will I make but a single remark concerning St. Elmo's fire, that peculiar, lambent light which is sometimes seen on church spires. This fire, resembling phosphorescent light, sometimes plays lightly over the surface of depending projections of a storm-cloud. This phenomenon was particularly noticeable during a storm on the evening of June 7, 1874.

Lightning sometimes appears of a brilliant white color, and at other times of a purple or rose-colored tint. Lieut. Arthur mentions red, and also blue lightning, in his account of the Barbadoes hurricane of 1780. It has been determined that when the cloud floats comparatively near the earth the lightning is white, and when occuring at great elevations the flash is of a reddish or purple hue. The colored tints are evidently due to the rarity of the air; for the same effects are produced when an electric spark is made to pass through the air of a partially-exhausted receiver.

A certain modern philosopher says: "It is strange how strongly some errors retain their hold on the minds of men;" and the tenacious property of error is illustrated in the persistence with which some meteorologists uphold the theory that the rumblings and detonations of thunder are successive echoes reflected from the clouds.

Now, as every one knows, the lightning passing through the atmosphere, moves in broken, zigzag lines, so that, in one part of its course it may be going either *toward* or *from* us, and in another in a line at right angles or obliquely to its former direction. From every point of its course the sound of thunder proceeds. Now the velocity of sound is about 1,000 feet per second. Let us suppose a portion of the lightning's track 2,000 feet in length lies in a line, the more distant extremity of which is 2,000 feet farther from us than the other, then will the report of the thunder be two seconds sounding in our ears; while, on the other hand, should the discharge occur in a line at right angles to this one, the report would be of but an instant's duration—the vibrations reaching us from all points of the line during a single second. It is obvious, therefore, that in the former case, the intensity of the sound would be but half as great as in the latter. The different conditions of distance, direction, and intensity of the electric discharge are sufficient to account for nearly all the modifications of the voice of the thunder, which we inhabitants of the plains ever hear. In mountainous districts there are frequently echoes from mountain sides; and this is an effect most natural, but the idea that thunder is echoed from walls of vapor, like the clouds, is little short of the absurd—at any rate those should not entertain the idea who believe that the sound of *thunder* can penetrate but twice as far as that of a base drum.

In some of our text-books on Physical Geography, it is stated that thunder is never heard at a distance of more than *ten* miles. The truth is, thunder is not generally heard until the storm is within forty miles of the observer's locality; but it may be heard from one hundred to one hundred and fifty miles, if the conditions are favorable. When the top of the storm-cloud is about ten degrees above the horizon, it is then some one hundred and fifty miles distant. If the weather is very warm, it may be even more than this. If it is moving in the direction of the observer it will reach his locality within from four to six hours, since these storms move, as a general thing, from twenty-five to forty miles per hour. Some storms, however, move much more rapidly than this. One occurring in May, 1873, reached Dubuque, Ia., at 10.00 A. M., Morrison, Ill., at 11, and Ottawa, Ill., at noon.

When the Mineral Point tornado occurred, May 23d, 1878, the summit of the cloud, viewed from this locality, was about fourteen degrees above the horizon, and thunder was distinctly heard—distance about eighty miles. On the same evening, lightning flashes blazed constantly from a cloud about ten degrees high, directly in the east. The storm was raging at the time in the vicinity of Chicago, and the thunder was distinctly audible. This storm had passed over Whiteside county (Illinois), during the afternoon, and was accompanied with terrific thunder.

In the month of June, 1867, during a protracted drouth, a shower came up one night accompanied with considerable electricity. It passed on to the eastward, and, at sunrise next morning, the corrugated edges of the thunder-cloud projected slightly above the horizon. No other clouds were visible in the heavens; yet thunder was distinctly heard several times, and even after the cloud had entirely disappeared. This is sufficient proof, with what has gone before, that thunder *can* be heard even *one hundred and fifty miles*. In the remarkable case here noted, a light breeze from the east, combined with certain other conditions, rendered the phenomenon possible. But yet, our school-book authors lay it down as a fixed law that thunder can be heard but *ten* miles! They do not make the least allowance for varying conditions. They do not take into consideration the fact that certain conditions of moisture of the air, either more or less, have their modifying effects; nor do they seem to know that when the soil is parched from long-coutinued drouth, it then serves as a ready transmitter of sound.

The height to which a thunder-cloud ascends sometimes exceeds six miles. When five and a half miles high, it can readily be seen 200 miles.

[*To be Continued*]

MEAN ITALIAN THERMOMETER READINGS.

FURNISHED BY ERMINE CASE, JR.

	MILAN.	FLORENCE.	ROME.	NAPLES.
Saturday, Dec. 4, 1880 . .	38° F.	47°	59°	62°
" " 11, 1880 . .	42°	50°	55°	63°
" " 18, 1880 . .	44°	43°	50°	49°
" " 25, 1880 . .	42°	48°	50°	51°
" Jan. 1, 1881 . .	50°	52°	58°	61°
" " 8, 1881 . .	44°	49°	55°	52°
" " 15, 1881 . .	38°	44°	45°	51°

METEOROLOGICAL OBSERVATIONS AT WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL.

The last eleven days of January were milder than the first twenty, which were reported last month, but the average temperature was only 20°. The lowest temperature of this decade was 2° above zero, and the average of minima was 11.6°. The first decade of February was warmer, the average of minima being 20.5° above zero and the mean temperature 28.8°. The last decade of this report, which closed Feb. 20th, shows that another cold term has prevailed, and reports from many quarters indicate that the storms have been almost beyond precedent in their extent and severity. There had been no sleighing in Topeka until the 11th of February, when a snow storm began that lasted more than 24 hours. From noon on the 11th to noon on the 12th the wind traveled 1129 miles; direction from the northwest. This distance is greater by more than 100 miles than any previous record since our anemometer was set up, last May. The velocity was upwards of 50 m. per hour much of the time. Following this were several days of exceedingly cold weather—the minimum on the 15th being 9° below zero, and on the 16th 11° below zero. On the 19th it was 6° below zero. Another snow storm occurred on the 14th, and still another on the 17th. The total depth of snow at any one time on the prairie, where not drifted nor blown off, was seven or eight inches. There have been many parhelia of great bril liancy, both morning and evening. The lowest barometer, 28.59, accompanied the rain storm of the 5th. In the second decade the N. and N. W. winds have prevailed, and, as usual, the barometer has been higher.

The following table gives these results by decades:

RECORDS DEDUCED FROM AVERAGES OF DAILY OBSERVATIONS.

	Jan. 20th to 31st.	Feb. 1st to 11th.	Feb. 10th to 20th	Mean.
TEMPERATURE.				
Min.	11.6	20.5	3.0	11.7
Max.	31.9	37.8	22.4	30.7
Mean of Max. and Min.	21.8	29.1	12.7	21.2
Range.	20 3	17.0	19.4	18 9
7 a. m.	15 0	24.8	6.5	15.4
2 p. m.	24.8	38.8	18.7	25 4
9 p. m.	20.1	28.9	12.0	20 4
Mean	20.0	28.8	12.4	20.4
REL. HUMIDITY.				
7 a. m.	. .	.86	. .	. .
2 p. m.	. .	.81	. .	. .
9 p. m.	. .	.85	. .	. .
Mean	. .	.84	. .	. .
PRESSURE, sea-level, 32° F.				
7 a. m.	29.00	28.85	29.08	29 01
2 p. m.	29.00	28.83	29 06	28.99
9 p. m.	29 11	28.84	29 09	29 01
Mean	29.10	28.84	29.08	29.01
WIND.				
Miles Traveled	3,955	3,656	4,771	. .
RAIN AND SNOW.				
Inches melted	. .	1.6	1.0	2.6

DUST AND FOG.—BENEFICIAL EFFECTS OF SMOKE.

Mr. John Aitken recently read a paper before the Royal Society of Edinburg on the origin of fogs, mists and clouds. From a great number of experiments with moist air at different temperatures, to determine the conditions which produce condensation of water vapor, he concludes that whenever water vapor condenses in the atmosphere, it always does so on some solid nucles; that dust particles in the air form the nuclei on which the vapor condenses; that if there were no dust there would be no fogs, no clouds, no mists, and probably no rain; and that the supersaturated air would convert every object on the surface of the earth into a condenser on which it would deposit as dew; lastly, that our breath, when it becomes visible on a frosty morning, and every puff of steam, as it escapes into the air from an engine, show the impure and dusty state of the atmosphere. These results have been verified at temperatures as low as 14° Fah., at which, however, there was little cloudiness produced, owing to the small amount of vapor in air so cold. The sources of this dust are many and various; for instance, finely ground stone from the surface of the earth, the ash from exploded meteorites, and living germs. Mr. Aitken showed experimentally that, by simply heating any substance, such as a piece of glass, iron or wood, a fume of solid particles was given off, which, when carried along with pure air into a receiver, gave rise to a dense fog mixed with steam. So delicate is this test that the hundredth of a grain of iron wire will, when heated, produce a distinct haziness in the receiver. By far the most active source of these fog-producing particles is, however, the smoke and sulphur given off by our coal fires; and as even gas grates will not prevent the emission of these particles, Mr. Aitken thinks it is hopeless to expect that London, and other large cities wherein such fuel is used, can ever be free from fogs. However, inasmuch as more perfect combustion will prevent the discharge of soot flakes, these fogs may be rendered whiter, purer, and therefore more wholesome, by the use of gas grates, such as that recomended by Dr. Siemens. Mr. Aitken also drew attention to the deodorizing and antiseptic powers of smoke and sulphur, which, he thinks, probably operate beneficially in killing the deadly germs and disinfecting the foul smells which cling about the stagnant air of fogs, and suggests caution lest, by suppressing smoke, we substitue a greater evil for a lesser one.—*Scientific American.*

BOOK NOTICES.

Natural Science and Religion, by Asa Gray. pp. 111, octavo. Chas. Scribner's Sons, N. Y., 1880, $1.50.

This little work is made up of two lectures delivered by Prof. Asa Gray to the Theological School of Yale College; the first upon Scientific Beliefs, and the second upon The Relations of Scientific to Religious Belief; and, since whatever this eminent naturalist contributes to the literature of science carries with it indisputable force and weight, it is unnecessary to say that they comprise the sum of what is known and believed by the best and most profound thinkers and experimenters in natural science and biology. His vast experience and skilled observations give him a position among scientists that few Americans occupy, and these lectures are read by old and young, creationists and evolutionists, with respect and confidence.

In the first lecture he traces the rise and abandonment of numerous beliefs; as that plants and animals are composed of different ultimate materials, whereas the essential oneness of the two kingdoms of organic nature is now a new article of scientific creed; the idea that the characteristic features of an animal were a mouth and a stomach, whereas it is now known that entozoa feed like rhizophytes and turbellarias and their relatives have no alimentary canal, the food taken by what answers to mouth passing as directly into the general tissue as does the material which a parasitic root imbibes from its host or an ordinary root from the soil; more recently, even the faculty of automatic movement is believed to belong to certain vegetables instead of being a special attribute of animals only.

The hypotheses of natural selection, origin of species, etc., are all taken up in their turn and explained in the light of the most modern discoveries, and their errors as well as their established facts clearly and fairly pointed out.

In the second lecture the distinguished and venerable author considers the attitude that thoughtful men and Christian believers should take respecting the scientific beliefs of the present day and how they stand related to beliefs of another order. In reference to Darwinism, which he declares to be entirely and clearly distinct from monistic and agnostic philosophy, he says:—"As theists we are not debarred from the supposition of supernatural organization, mediate or immediate. But suppose the facts suggest and inferentially warrant the conclusion that the course of natural history has been along an unbroken line; that—account for it or not—the origin of the kinds of plants and animals comes to stand on the same footings as the rest of nature. As this is the complete outcome of Darwinian evolution, it has to be met and considered." Christian theists "should not denounce it as atheistical or as practical atheism or as absurd," but give it the most complete investigation from the highest summits of scientific knowledge and research.

As before stated, there is no work on this subject more deserving of our studious and respectful examination.

History of the Christian Religion to the Year 200. By Charles B. Waite, A. M.; pp. 455, 8 vo. Chicago; C. V. Waite & Co., 1881. For sale by M. H. Dickinson. $2.50.

The author of this work claims that his intent to publish it was formed after ascertaining facts and arriving at conclusions which appeared of great importance, and which had never before been made fully known. He also assumes that it will be found the most complete record of the events connected with the Christian religion during the first two centuries which has ever been presented to the public. Whether these assumptions are fully borne out is possibly questionable, but that the work is the result of extensive reading and study, both of ancient and modern writers, and therefore well worth the examination and investigation of all readers, is unquestionable.

The book is divided into six periods. First, The Apostolic age, A. D. 30 to A. D. 80; second, the Apostolic Fathers, A. D. 80 to 120; third, the Three Apochryphal Gospels, A. D. 120 to 130; fourth, Forty Years of Christian Writers, A. D. 130 to 170, fifth, the Four Canonical Gospels, A. D. 170 to 185; sixth, close of the Second Century, A. D. 185 to 200.

The first statement that attracts attention is that the gospels of the first century, with the exception of the epistles of Paul, the one epistle of Clement of Rome, a few legends and tradition, etc., are lost; also the great body of the Christian literature of the second century has been destroyed. Later, the author states, in a review of the third and fourth periods, that in the whole mass of Christian literature cited by him, including the writings of twenty-six Christian authors, besides others of note, there is not to be found a single mention of the canonical gospels; not a reference to Matthew, Mark, Luke or John, as the author of a gospel. Still later, he states, as a result of his investigation, that "no evidence is found of the existence, in the first century, of either of the following doctrines: the immaculate conception, the miracles of Christ or his material resurrection. Finally, he declares that, notwithstanding all these absences and failures in what are usually regarded as authoritative writers and doctrines, the divine teachings of Christ, "unlike the books referred to, can be traced back to well authenticated records of the first century."

Giving Mr. Waite all credit for laborious overhauling of authorities among early and later writers, and accepting his copious quotations as correct, and even allowing that his motives and purposes in the investigations he has made were pure and in the interest of exact history, we yet fail to be convinced that he has had access to better authorities or has read them to better effect than the thousands of scholars who have preceded him, who, doubtless, were actuated by as lofty motives in their researches, and who, doubtless, were as honest in their conclusions, though differing so widely from his own.

Mr. Waite fixes the date of the canonical gospels approximately thus: Luke, A. D. 170: Mark, 175; John, 178; Matthew, 180. It seems impossible that such writers as Origen and Irenæus, whose testimony shows that Matthew's gospel was written about A. D. 58 to 60, should be so far mi taken; while the internal evidence of Mark's gospel (xiii–13, 24, 33), proves that it written before the destruction of Jerusalem. Luke's gospel is known to have been in use before A. D. 120, and the internal evidence (Acts i, 1), proves that it was written before the Acts, which, since the latest time actually mentioned in the latter is the period during which Paul lived at Rome, must have been before the year 63. John's gospel was written later, probably during his sojourn at Ephesus, in A. D. 66, or perhaps as late as 78. Scholars of the most undoubted erudition and fairness, after the most laborious and careful research, have agreed upon these dates, which have thus far withstood all efforts to materially change them.

Many other statements of Mr. Waite are in direct conflict with the ordinarily accepted beliefs of the Christian world, and many of the authorities relied upon by him are rejected by other scholars; but, as we have before said, his book shows thc expenditure of laborious examination of many authors, and will be an interesting study for all classes of readers.

CHAPTERS FROM THE PHYSICAL HISTORY OF THE EARTH. By Arthur Nicols F. G. S., F. R. G. S.; pp. 281, 12 mo.; Harper & Bros., New York; For Sale by Kansas City Book and News Co.; $1.50.

The object of the author of this work in adding another to the long list of geological text-books, is to bring the information we have on the subject to a focus and direct it to the elucidation of the physical and biological history of our planet. The work is divided into two parts, Geology and Palæontology, each comprising six chapters on the appropriate subjects which are treated ably and comprehensively. The Palæontological part will be found especially full and valuable, since in that department it is possible to present new facts and discoveries, and advance the new theories growing out of them. The last chapter, that on Fossil man, sets forth fully the Monogenistic and Polygenistic theories; man's position on the earth, zoölogically considered; his structure and relationships with lower animals; growth of speech, etc., etc., with an account of the very latest discoveries of human fossil remains, and the opinions of the most scientific men of the present day regarding man's antiquity.

One marked improvement in this book over most geological works is, that in place of the old engravings that have been handed down from the days of Hitchcock, a number of new ones are introduced to illustrate the text. This will be appreciated at least by all middle aged, or elderly readers, to whom the others have long since become more familiar even than "household words."

CURIOUS MYTHS OF THE MIDDLE AGES: By S. Baring-Gould, M. A.; pp. 453, 12 mo. Boston: Roberts Brothers, 1880. For sale by M. H. Dickinson, $1.50.

Among the mediæval myths described and explained in this volume are those of the Wandering Jew; Prester John; The Divining Rod; The Seven Sleepers of Ephesus; William Tell; Anti-Christ and Pope Joan; The Man in the Moon; St. George; The Fortunate Isles, and many more; all of which are handled familiarly and skillfully by the author. He has selected myths of whose origin and history very little is really known by most readers, although their titles are well known to all. In doing this work he has laid under obligations the mass of the reading public, who are also indebted to the publishers for their part of the work.

SPANISH SELF-TAUGHT. By Franz Thimm; pp. 83, 12 mo.; Kansas City Book and News Co., 1880; 25 cents.

This will be found a very useful hand-book to the people of the West, so many of whom have business and social relations with those of Old and New Mexico, where the Spanish language is almost universally spoken. It consists of a grammar and a reader, with English pronunciation and translation of every word, phrase, and sentence; so that by it alone a stranger can make himself understood by a native wherever the Spanish language is spoken, or written.

OTHER PUBLICATIONS RECEIVED.

Transactions of the Wisconsin Academy of Sciences, Arts and Letters. Vol. I 1870–2, Vol. II 1873–4, Vol. III 1875–6, Vol. IV 1876–77. Proceedings of the Boston Society of Natural History; Vol. XIX. Part 1, October, 1876, to March, 1877; Part 2, March, 1877, to May, 1877; Part 3, May, 1877, to March, 1878; Part 4, March–April, 1878. Vol. XX. Part 1, May to November, 1878; Part 2, November, 1878, to April, 1879; Part 3, April, 1879, to January, 1880. Archæological Explorations of the Literary and Scientific Society of Madisonville, Ohio. Part 1, 1878–9; Part 2, September 1 to December 31, 1879; Part 3, January to June 30, 1880. Proceedings of the Iowa Academy of Sciences, 1875–80. Forest and Forestry, from Report of State Board of Agriculture of 1880, by Thos. Meehan; On the Timber Line of High Mountains, from Proceedings of the Academy of Natural Sciences of Philadelphia, 1880, by Thos. Meehan. The Geology of Central and Western Minnesota, Preliminary Report of Warren Upham, Assistant State Geologist, 1879; The Succession of Glacial Deposits of New England, by Warren Upham. The Kindergarten Messenger and the New Education, Syracuse, N. Y., 1881, $1.00 per annum; Hardwicke's Science Gossip, January, 1881, London, 5d. Proceedings of the Poughkeepsie Society of Natural Science, October, 1879, to July, 1880. Quarterly Report of the Kansas State Board of Agriculture, for the quarter ending December 31, 1880, J. K. Hudson, Secretary. Circular (No. 4) of Information of the Bureau of Education, Rural School Architecture, with Illustrations; Circular No. 5, English Rural Schools.

SCIENTIFIC MISCELLANY.

DEEP SEA DREDGING.

In the opinion of Prof. A. E. Verrill of Yale College, the recent deep-sea dredging expedition off the coast of Rhode Island, on the edge of the Gulf Stream, under the auspices of the United States Fish Commission, proved the most successful ever sent out by this or any other country. In three days more specimens were obtained than by any other expedition in as many months. Indeed, the English expedition on the Challenger, which was at work deep-sea dredging for five years continuously, did not accomplish more or get a larger collection.

The dredging was done from seventy-five to one hundred and fifteen miles south of Newport, in the region known on the charts as Block Island soundings, the depth of the water being from one-quarter to three-quarters of a mile. The specially constructed steamer Fish Hawk, fitted up with the most approved scientific appliances, was used, and the expedition was under the direct charge of Prof. Baird of Washington. The ground was especially favorable. A peculiar beam trawl was used for scraping the bottom of the ocean. It was a net forty or fifty feet long. The mouth of it was spread open by an oak beam fifteen feet long and six inches in diameter. The beam rested upon heavy iron runners, to keep the net-work bag about two feet off of the bottom. The lower side of the mouth of the net was formed of a receding rope, weighted with lead. This rope dragged along the bottom and scraped the shell-fish, shells and what not into the net. Fish swimming at that depth were also scooped in, and once inside they were entangled in pockets that prevented their escaping.

This trawl would be thrown out and drawn along behind the steamer, making a swath half a mile long and twelve or fifteen feet wide. Then a powerful hoisting engine would be set to work and the trawl and its contents hoisted aboard the steamer. As many as four thousand pounds weight of stuff would be taken from the bottom of the ocean each time the trawl was hoisted. Two barrels of alcohol a day were used in preserving rare specimens. To put them in shape will be the work of weeks. To thoroughly arrange and classify the thousands of specimens obtained, will occupy the commission all winter. Most of this work will be done by Prof. Verrill and his assistants.

Eighteen species of fish were caught heretofore unknown and undescribed, besides others known to Greenland and Northern Europe, but not to our coast; also a wonderful variety of crabs, shrimp and lobster-like creatures, some of them very handsome, and forty species of them entirely new. One hundred and fifty-five different kinds of shells, one hundred and fifteen of them not before known on this part of the coast, fifty-five not known as inhabitants of American waters, and thirty wholly unknown to scientists heretofore, were obtained. In addition, two new kinds of devil-fish, one about a foot long; two hundred specimens of a new and pretty squid, and twenty new kinds of star-fish were taken. Of these star-fish thousands of specimens were netted, some of exceeding beauty. Quite a number of new species of corals were caught, some of them being brought up by the bushel. Of fan coral some beautiful specimens were obtained. Hundreds of sea anemones, brilliantly colored, some of them measuring a foot across, delighted the eyes of the men of science. One strange discovery was a worm inhabiting a quill like a goose-quill. The quills were about a foot long, and soon after being taken out of the water grew so hard that they could be and were used for pens. They stood up in the mud at the bottom of the sea. The worms inside were opal-colored, and when taken out of their strange tenements glistened and presented a rather pretty appearance, so far as color was concerned. They were raked up by thousands, and none of the scientific men ever heard of them before.

The discovery was made that the tilefish is plentier than the cod. A Glouces ter fisherman last winter hauled in the first tilefish. Since then few have been caught. Prof. Verrill, however, caught three with a perpendicular trawl line. On opening their stomachs he found therein some of the rare crustaceæ that abounded thereabout, and he knew it was their feeding ground. He is satisfied that they are plentier there in season than codfish off Block Island. One of the fish caught weighed fifty pounds. The tilefish, as described by Prof. Verrill, is a magnificent fish of a light, yellow-brown color, shaped like a sea-bass, and spotted all over with yellow. It is fine eating, and he is convinced that it is destined to become a favorite market fish, now that it is known where it can be readily caught.

All of the fish caught by the dredges have gone to the headquarters of the commission in Washington. The other specimens came here in many boxes a few days ago, and the work of arranging them is now being pushed forward. As many as one hundred series of the various specimens will be made up and dis tributed among the museums of the country, the first choice going to the National Museum at Washington, the second to the Peabody Museum here, the third to the museum at Cambridge, and so on. A complete and detailed report will also be made by the commission.

The records of the temperature at different depths were always made with great care. At a depth of from 100 to 142½ fathoms the temperature was usually from 51° to 53° Fahrenheit. From 142½ to 325 fathoms it was from 42° to 43°, and at 500 fathoms it was 40°. The pressure at 500 fathoms or over was very great—sufficient to crush and press together the wood that incased the thermometer until it was a shapeless mass, and to so press the rope used to lower the instrument, that it came up hardened and squeezed together until it resembled a bar of metal.

In the nine years the Fish Commission has been established it has dredged in 2,000 localities (both shallow and deep waters), between Long Island Sound and Halifax, and out as far as 200 miles; but never before did they have such good luck as last month on the Fish Hawk.—*N. Y. Sun.*

A LOST CITY.

GOUR, THE RUINED AND FORGOTTEN CAPITAL OF BENGAL.

Among the marked peculiarities of Anglo-Indians is one which we have never heard fully explained. As a rule, they know nothing about India. They are not interested in it, and do not study it, do not take even the trouble to see the wonderful things of which the country is full. We should like to know how many Anglo-Bengalees know anything of the marvelous city of which the name stands at the head of this article; Gour, the ruined capital of Bengal, the Ganga Regia of Ptolemy, where Hindoo kings are believed to have reigned 2,000 years ago, where semi-dependent Mussulman rulers undoubtedly governed Bengal before Richard Cœur de Lion died, and where Kai Kaus Shah, 1291, founded a sovereignty, which, under the different dynasties, one of them Abyssian, endured to 1537. These kings made Gour, by degrees, one of the greatest cities in the world—greater, as far as mere size is concerned, than Babylon or London. Mr. Ravenshaw, a civilian, who took photographs of every building he could reach, photographs published since his death, believes the ruins to cover a space from fifteen to twenty miles along the old bed of the river, by three miles in depth, a space, which, after allowing for the rich native method of life, with its endless gardens and necessity for trees, must have sheltered a population of at least 2,000,000. These kings must have been among the richest monarchs of their time, for they ruled the rice garden of the world, Eastern Bengal, where rice yields to the cultivator 160 per cent; they controlled the navigation of the Ganges, and their dominion stretched down to the Orissa, where the native princes—how strange it sounds now, when Orissa is a province forgotten, except for an awful famine!—were always defeating their troops. They spent their wealth necessarily mainly on a mercenary army, often in revolt, for their Bengalees could not fight the stalwart peasants who entered the army of the Kings of Behar, and their fleet could not always protect the weak side of the capital; but they covered the city with great structures, opened "broad, straight streets, lined with trees," and built inner and outer embankments of this kind:

"The boundary embankments still exist; they were works of vast labor, and were, on the average, about 40 feet in height, being from 180 to 200 feet thick at the base. The facing throughout was of masonry, and numerous buildings and edifices appear to have crowned their summits; but the whole of the masonry has now disappeared, and the embankments are overgrown with a dense jungle, impenetrable to man, and affording a safe retreat for various beasts of prey. The eastern embankment was double, a deep moat, about 150 yards wide, separating the two lines. A main road ran north and south through the city, its course being still traceable by the remains of bridges and viaducts. The western face of the city is now open, and probably always was so, having been well protected by the Ganges, which, as has already been observed, ran under its walls. In the center of the north and south embankments are openings, showing that these fortifications have been perforated to afford ingress to and egress from the city. At the northern entrance there are no remains, but at the southern still stands the Kutwali gate, a beautiful ruin, measuring fifty one feet in height, under the archway. Within the space inclosed by these embankments and the river stood the City of Gour, proper, and in the southern corner was situated the fort, containing the palace, of which it is deeply to be regretted that so little is left. Early in the present century there was much to be found here worthy of note, including many elegantly carved marbles; but these are said to have become the prey of the Calcutta undertakers and others for monumental purposes. On the roadside, between the palace and the Bhagirathi River, there now lies split in twain a vast block of hornblende, which, having been carried thus far, has been dropped and left as broken on the highway, to bear its testinony against the spoilers. Surrounding the palace is an inner embankment of similar construction to that which surrounds the city, and even more overgrown with jungle. A deep moat protects it on the outside. Radiating north, south, and east from the city, other embankments are to be traced, running through the suburbs, and extending in certain directions for thirty or forty miles. These include the great causeways or main roads leading to the city, which were constructed by Sultan Ghivasuddin. The greater part of them were metaled, and here and there they are still used as roads, but most of them are, like those within the city, overgrown with thick jungle."

Within the embankment, ten miles by three, the kings constructed splendid mosques by the dozens; palaces, public buildings, deep and huge reservoirs, and so many houses, that after three centuries of spoilation, "there is not a village, scarcely a house, in the district of Maldah (which is as big as an English county), or in the surrounding country, that does not bear evidence of having been partially constructed from its ruins. The cities of Murshidabad, Maldah, Rajamahal and Rangpur, have almost entirely been built with materials from Gour, and even its few remaining edifices are being daily despoiled." The kings built in brick and stone, and used for many mosques a material which Mr. Ravenshaw calls marble, but is more like what a hard freestone would be if it could be a deep coal-black. The quarries from which the material was obtained are still, as far as we know, uncertain; but it must have existed in enormous quantities; it took the chisel perfectly, and it appears inaccessible even in that destructive climate, to the effect of time. We have seen a mantelpiece of it, engraved with the Mohammedan profession of faith, known to be 800 years old, and the letters, cut to the depth of a line, are as clear as if the work had been done yesterday. The Gour architects built splendid Saracenic arches, gateways, and domes, and spared no expense or time on elaborate decoration, in a style which deserves separate study, for it marks the deep influence of Hindoo antiquities on men who were recently Mussulmans, and probably Moors from Spain. There is evidence that the grandeur and luxury of the city made a deep impression in Asia, for in one or two of the later Arabian stories it is treated as country-folk treat London;

while its civilization and polish so impressed the people, that to this hour a Bengalee Pundit, desirous of describing and honoring his native tongue, calls it not Bengalee, but *Goureye bhasha*, "The tongue of Gour," just as a Frenchman says, "That is Parisian."

And then, as it were in a day, the city died. The native tradition is that it was struck by the wrath of the gods, in the form of an epidemic, which slew the whole population; but it is more reasonable to believe, with Mr. Ravenshaw, that the epidemic, probably akin to cholera, finished a ruin partly accomplished by war and by the recession of the Ganges, which, after cutting its way into a channel four miles off, is now slowly cutting its way back again.—*London Spectator.*

A SHORT STORY OF THE OBELISK.

BY LIEUT.-COMMANDER GORRINGE.

Lieut.-Commander Gorringe, who has successfully brought the obelisk from its Alexandrian home to our Central Park, told the story of the Egyptian monument before the New York Association for the Advancement of Science and Art in the Brick church, at Fifth avenue and Thirty-seventh street, last evening. Thirty-five centuries have passed, he said, since the obelisk was severed from its natural surroundings by the hand of man and wrought into its present form. On the banks of the Nile, about six hundred miles from the sea, is an immense mass of granite, known as syenite, noted for its freedom from cracks, veins or foreign substances, and the beautiful polish of which it is susceptible. An obelisk now standing at Heliopolis, five miles from Cairo, taken from this quarry, was erected more than four thousand years ago; and four thousand years ago a priest quarried from this place, and transported six hundred miles, a shaft weighing one hundred and fifty tons, which was so highly polished that the polish still remains. With all the science of our own day, it would tax the most skillful workmen to reproduce the figures cut upon that shaft, and then give the surface such a lasting polish.

"On the base of the obelisk of Hatazon," continued the speaker, "it is recorded that only seven months elapsed from the time she gave the order to quarry the stone to the date of its final completion. To me this record means that the ancient Egyptians were possessed of mechanical appliances superior to those in use at the present day. By taking time enough, and employing men enough, there is hardly a limit to the weight that can be moved, but in the creation, transportation, and erection of an obelisk, the number of men is limited to comparatively a few, and I am quite sure that there is not a man living who would undertake in seven months, upon the penalty of his life, to quarry, transport six hundred miles, erect, carve and polish a granite shaft one hundred and twenty feet long, weighing three hundred and fifty tons, such as that of Queen Hatazon at Karnak. I dwell on this fact so that you may realize that in spite of the wonderful progress made in the mechanical arts of this country, we are, perhaps, only on the threshold of the knowledge possessed by the ancient Egyptians thirty-five centuries ago. In my opinion an obelisk is simply the representation of the creative power; it was unquestionably designed to stand before a temple; the proportions between its heighth and that of the wall or pylon against which it was seen projected, were invariably such that from every point of view the pyramidion of the obelisk was seen above the top of the temple. Obelisks are always erected in pairs; unfortunately, we have but one, and it is not reasonable to expect that we can get another one from Egypt; in fact, I have good ground for assuring you that there is not the least hope of our getting another Egyptian obelisk, until we can buy one from the European residents of Egypt. But I can see no reason for not having another obelisk, cut out of the beautiful red granite of Connecticut, and erected on a neighboring knoll, on which there could be cut a brief historical record."

He then gave an extended account of the hieroglyphics, which have before been fully described, and gave some facts about Thothmes III., Rameses, Thebes, Memphis, and Lucius Verus. "Thothmes was enabled to conquer Asia and exact tribute from the most powerful Asiatic kingdoms. He built new temples and restored others that had been destroyed by the Asiatic conquerors. Among the latter was the Temple of On at Heliopolis. Before that temple he erected a pair of obelisks, of which ours is one.

"Cleopatra had nothing to do with our obelisk. She died eight years before it was removed by the Romans from Heliopolis to Alexandria, for, as you are doubtless aware, the Latin and Greek inscription on the claw of the copper crab, found between it and its pedestal, states that it was re-erected at Alexandria in the eighth year of Augustus, which correspond to the twenty-third before Christ."

—*New York Times.*

STEAM HEATING FOR CITIES.

To speak of a man's warming his hands in his own parlor by the heat of a fire a mile distant suggests an exploit of sorcery; yet for several years such a thing has been possible to the citizen of Lockport, N. Y. If he will, he may break up his stoves and sell them for old iron: one furnace is henceforth to do the work of a thousand, and distribute its heat to the houses of an entire city by the agency of the good servant, steam. The process was invented and put into practical operation by Mr. Birdsill Holly.

Near the center of the city stands a plain brick building, from whose one tall chimney clouds of black smoke are constantly ascending. This is the boiler-house, and here in a row are the four great boilers in which the steam is generated. Three are horizontal, fifteen feet in length by five in diameter. The fourth is of about the same capacity as its companions, but different in shape; it looks like a gigantic bell dropped down upon the furnace, and is familiarly known to the workmen, not as "the upright," but as "the nigger." An iron pipe, eight inches in diameter, receives the steam from these boilers; yonder, back of the nigger, it passes into the ground. Outside the building, we might trace its course along the street by the black line of bare soil, from which it has melted away the snow.

This pipe is laid at a depth of three feet below the surface, sheathed in non-conducting materials, and inserted in logs of wood bored for the purpose. As the distance from the boiler-house increases, it diminishes in size from eight inches to one or one-half, to correspond with the amount of steam passed through it. At intervals of one or two hundred feet are placed wooden "service boxes," in which the expansion and contraction of the pipe under different temperatures is provided for by a nickel joint; from these boxes, also, the branches of the main diverge, and the service pipes are sent out to the buildings heated. The whole distributing system is divided into sections, from any one of which, in case of necessity, the steam can be excluded, without affecting the others.

As it is but a few years since this new method of heating had its origin in Lockport, we cannot expect to find it universally adopted. But here is a pleasant, home-like, private house warmed these two winters by the city furnace, from which it is distant perhaps half a mile. It is a cold, January day, but, as the outer door closes behind us, we find ourselves in a genial, summer-like atmosphere. No cheerfully glowing grate, no ugly, black register, is to be seen in the parlor; against the wall stands the radiator, with its polished marble cap and single row of delicately painted tubes. It is a hint of the housekeeper's millennium, when dust and coal-ashes, her omnipresent foes, shall be brought into subjection.

In the kitchen the family washing is in progress without any aid from the stove. Heat is conveyed to the boiler and tubs through rubber tubes attached to the service pipes. The water in the bath-room above is heated by a similar arrangement. There is no nerve-startling hiss as the steam escapes; that ingenious invention called the "anti-thunder box" reduces it to perfect quiet.

In the basement, also, we find the regulator. Perhaps at this moment the pressure in the boiler and mains may be forty or sixty pounds; in the house, as we ascertain by glancing at the gauge, it is only five. This reduction of pressure is due in part to the fact that, upon reaching the regulator valver, the water of condensation contained in the pipes is wire-drawn, and thus to a great extent reconverted into steam before being diffused through the building. Connected with the regulator is a steam-meter, which registers the number of pounds consumed daily, and also the hour at which each radiator in the house is opened or closed.

What becomes of the used steam? It is condensed upon leaving the radiator, and, in the form of hot water, returns to the basement. There, within a brick-walled inclosure, it circulates through several coils of pipe, exposed to a current of cold air. This air, warmed in its progress through the cooler, passes upward by a register into the apartment above, which it serves to ventilate. The water accumulates in a tank, the surplus being discharged into the sewer. Dip up a glassful from the tank. It is purer than a draught from any spring; it is the distilled water of chemistry. Should steam-heating ever become universal in our cities, there will be no danger of drawing up death from the well, no need of building expensive aqueducts and reservoirs; the same pipe that warm our houses will furnish us with water for every domestic purpose.

Steam has been made as subservient to the comfort of man as gas. What will science do for us next? Will the model city of the future be lighted by electricity, heated by one central furnace, and have its dinners sent in from the common kitchen through pneumatic tubes?—*Atlantic Monthly, March, 1881.*

PAPER CAR WHEELS.

How these are made are thus explained in the *Paper World:* "The paper is straw-board of rather fine texture. It is received in the ordinary broad sheets, differing in no particular from those used for straw-board boxes or other similar work. These sheets as they come from the paper mill are square, and are first cut to a circular pattern. This is done on a table with a knife guided by a radial arm. A small disc is also cut from the center of the sheet to admit the wheel center. The paper has now to be converted from loose sheets into a compact, dense body, capable of withstanding the tremendous crushing force to which it will be subjected in the wheels. This is accomplished as follows: Ten sheets are pasted together, one upon another, making a disc about ⅓ inch thick. Enough of these discs having been prepared to fill a powerful hydraulic press, they are subjected to a pressure of 1,800 pounds per square inch. When removed the discs are hung on poles in a steam-heated loft and left six days to dry. Thicker discs are then made, each formed by pasting together two or three of those already finished. These are pressed and dried as before, and the process is repeated until a block is built 4 inches thick and of about the specific gravity of lignum vitæ. After each pasting and pressing, six days are allowed for drying, and when the block is complete it is left in a drying room until thoroughly seasoned. The next operation is that of turning the paper blocks to fit the steel tires and iron centers. This is done in lathes in the same manner as if the material worked on was tough wood. A bed or recess is worked out for the web of the tire to rest in. The block is then painted, and is ready for its place in the wheel."

The Chicago, Burlington and Quincy Railroad Company are burning clay for ballasting their road. A small fire of bituminous Iowa coal is started on the surface of the ground, and, when burning freely, the fire is covered with a layer of lumpy clay, then alternately coal and clay, the coal decreasing in quantity until at the top it is as one to fifteen. The mass is formed like a cone. Three united cones, each 18 feet high and containing in all about 1,000 cubic yards of material, have been started near Red Oak. They will burn for months.

The above map shows in a practical form the advantages of the three Isthmian routes from the Atlantic to the Pacific, so far as distance and directness are concerned. Each of these routes has been fully described in the North American *Review* and other periodicals; but this illustration, adapted from Captain Eads' article, is the only one we have seen giving the three in one comparative view.—[Editor.

EDITORIAL NOTES.

At the regular meeting of the Kansas City Academy of Science, in January, papers were read respectively by Mr. Coddington and Mr. David Eccles: the former upon the Cultivation of the Æsthetic in Industrial Pursuits, which was written in his usual elegant and attractive manner; the latter, a reply to Mr. Miller's criticisms of Herbert Spencer's philosophy, in which the author displayed his peculiar talent for metaphysical and philosophical discussion in a well and forcibly written defense of the Synthetic Philosophy.

At the meeting in February, Mr. Robert Gillham read the first of a series of papers on Sanitary Drainage of Cities, a subject to which he has given much attention, and one which is of vital importance to every citizen who expects to make this city his home. The second paper was read by Dr. R. Wood Brown, his subject being The Teeth in Relation to the Brain, illustrated by a large number of drawings prepared by himself, exhibiting the progressive development of the brain and teeth in the gradual ascent from the lowest to the highest grades of animal life. This lecture also was very instructive and was most attentively listened to by the audience.

At the March meeting papers will be read by Dr. Halley and Mr. Gillham.

Mr. Howard W. Mitchell, of Colorado Springs, Colorado, replies to an inquiry relative to the reported volcanic action on Pike's Peak, that "It is unnecessary to say that all such rumors are utterly without foundation in fact; no subterranean disturbance has, so far as known, taken place in Colorado during the past year, and the only remarkable atmospheric phenomenon was that which gave rise to the beautiful lunar rainbows a few nights since."

We have received from the publishers a copy of Prof. T. Berry Smith's chart entitled "The Circle of Sciences," intended for the use of teachers in instructing their pupils in Physical Science. The circle is three feet in diameter, the center being Matter, Force, Change, with the various departments and subdivisions radiating out from it. It is a comprehensive and readily comprehensible chart, and will be found of great advantage to teachers and students.

At the February meeting of the Kansas City Academy of Science, the Secretary called attention to the fact that the discovery of the *Icthyornis dispar*, the bird with teeth, ought, be credited to the late Prof. Mudge, instead of Prof. Marsh. The mistake is natural, as Prof Marsh figured and described this wonderful specimen, which was sent to him by Prof. Mudge.

A very partial friend at Plattsmouth, Nebraska, writes: "I receive most of the eastern and many foreign scientific periodicals, but not one which interests me as the Review does."

Boston Society of Natural History,
Boston, Mass., January 26, 1881.

* * * * *

We want several numbers of your magazine to complete our set. The society would be grateful to you if you could complete the set. Yours respectfully,

Edw. Burgess, Sec'y.

Columbian College, D. C.,
January 12, 1881.

Dear Sir:—I do not know of anything during the past year that gave me more pleasure than your account of your trip to New Mexico.

* * * * *

Yours with respect,

Otis T. Mason.

ITEMS FROM THE PERIODICALS.

THE *Rocky Mountain Medical Review*, edited by A. Wellington Adams, M. D., reaches Number seven of its first volume with the March issue. It is a handsome, ably conducted journal, published at Colorado Springs, Col. Among the original articles in the November number, besides that of Dr. Adams, on the Thermograph, copied in the REVIEW, this month, is a very excellent one upon "The Influence of Altitude upon Respiration," by S. E. Solly, M. R. C. S., which will be found of service to all who read it, whether medical men or invalids.

PRESLEY BLAKISTON, the well known publisher of medical works, in Philadelphia, has changed the title of his medical journal to *The American Specialist*, which is edited by Chas. W. Dulles, M. D., and published monthly at $1 50 per annum. It is attractive in appearance as well as valuable in substance.

THE *Humboldt Library*, Nos. 18 and 19, give respectively, "Lessons in Electricity," by Prof. John Tyndall, and "Familiar Essays on Scientific Subjects," by Prof. R. A. Proctor, at the usual low price of 15 cents each.

THE *Journal of the Anthropological Institute* (London) for November is just received. It presents a number of articles which cannot fail to interest its readers, among which are Notes on the Romano-British Cemetery at Seaford; Notes on Fijian Burial Customs; The Ethnology of Germany, etc., etc. This valuable periodical is published quarterly at $1 00 per number of 112 pages, and can be clubbed with the REVIEW at reduced rates.

HARPER'S MONTHLY for March offers the follows: Bedford Park, Moncure D. Conway; with eight illustrations. The University of Leiden, W. T. Hewitt; with ten illustrations. The Arran Islands, J. L. Cloud; with ten illustrations. Possibilities of Horticulture, S. B. Parsons; with nine illustrations. A Glimpse of an Old Dutch Town; with sixteen illustrations. Richard Henry Stoddard, a poem; Henry Ripley Dorr. The Grave-digger, Robert Herrick; with full page illustration by Abbey. A Nation in a Nutshell, Geo. P. Lathrop; with twelve illustrations. Anne; a novel, Constance Fenimore Woolson; with three illustrations by Reinhart. The French Republic, George Merrill. Hands Off; a story. A Talk on Dress, Maria R. Oakey. A Help-meet for Him; a story, W. M. Baker. The Family Life of the Turks, Henry O. Dwight. A Laodicean; a novel, Thomas Hardy; with an illustration by Du Maurier. Editor's Easy Chair; Editor's Literary Record; Editor's Historical Record; Editor's Drawer.

THE contents of *The Atlantic Monthly* for March, 1881, are as follows; Friends; a duet, VI—VIII; Elizabeth Stuart Phelps. Story of a great Monopoly; H. D. Lloyd. Arachne; Rose Terry Cooke. The Portrait of a Lady; XIX, XX; Henry James, Jr. The Seven Days; Francis L. Mace. New York Theaters. The Genesis of Genius; Grant Allen. Before Dawn; Maurice Thompson. The Wives of Poets, III; William M. Rosetti. The End of the War; Theedore Bacon. Random Recollections of England; Richard Grant White. Boston to Florence; Oliver Wendell Holmes. The Eleventh Hour; Katherine Carrington. Recent French and German Essays; War Ships and Navies; Tennyson's New Volume, and other Poetry; Challoner's History of Music; The Contributors' Club; Books of the Month.

THE *North American Review* has eight original articles by prominent writers, among which are Theology in the Public Schools, by Bishop A. C. Coxe; The Isthmian Ship Railway, by Captain James B. Eads, which is exhaustive in argument and fact, and which has one map that of itself is satisfactory evidence of the advantages of his route over all others; The Effects of Negro Suffrage, by Chief Justice H. H. Chalmers; The Success of the Free School System, by Prof. John D. Philbrick; Theological Charlatanism, by Prof. John Fiske, in which he handles Rev. Joseph Cook without gloves, etc., etc.

THE *Popular Science Monthly* is always welcome, but the February number is especially attractive, as will be seen from the following abstract of its contents: The Development of Political Institutions, by Herbert Spencer. IV. Political Differentiation.—Origin of the Plow and Wheel Carriage, by E. B. Tylor, F. R. S. (Illustrated.)—Physical Education, by Felix L. Oswald, M. D. II. Diet (continued.)—Horses and Their Feet, by Sir George W. Cox.—Domestic Motors, by Charles M. Lungren. III. Gas and Electric Engines. (Illustrated.)—The Value of Accomplishments, by William A. Eddy.—Darwin on the Movement of Plants, by Eliza A. Youmans. (Illustrated.) — Atmospheric Electricity, by Prof. H. S. Carhart.—Optical Illusions of Motion, by Silvanus P. Thompson, B. A., D. SC. (Illustrated.)—Evolution of the Chemical Elements, by Lester F. Ward.—Only a Vine-Slip, by Thomas G. Appleton.—The November Meteors, by Prof. Daniel Kirkwood.—Prehistoric Science en Fete.—Sketch of Count Pourtales. (With Portrait.)—Editor's Table.—Literary Notices.—Popular Miscellany.—Notes.

THE *Saturday Herald*, recently enlarged and improved, is now the recognized society paper of the city, patronized by all and contributed to by many of our best and most elegant writers. Mrs. Hicks has displayed remarkable talent in working it up to the present standard and deserves a support ample to make it a profitable investment.

PREMIUMS.

We have determined to continue the plan which proved so appropriate and acceptable last year, for giving premiums to our subscribers, viz.:

To any person who sends us $3.50 we will send the REVIEW for one year, and any $1.50 book published by D. Appleton & Co., S. C. Griggs & Co., Robert Clark & Co., Houghton, Mifflin & Co., Harper Bros., Roberts Brothers, J. B. Lippincott & Co., John Wiley & Sons, Henry C. Lea, S. R. Wells & Co., Ivison, Blakenan, Taylor & Co., Orange Judd & Co., etc.

To any one sending us $3.75 we will send the REVIEW for one year and any $2.00 book published by any of the above firms.

Persons desiring to subscribe for the REVIEW and purchase any book or books, or subscribe for any other periodical, published or obtainable in this country, can obtain special rates by applying to the editor in person or by letter.

Clubs desirous of subscribing for the REVIEW can have the same privilege as single individuals, besides the advantage of reduced rates of subscription.

To persons who wish to purchase law, medical, scientific or miscellaneous books, and at the same time subscribe for a periodical which includes within its scope popular articles upon all branches of science, mechanical arts and literature, we deem this a particularly favorable offer.

BACK NUMBERS.—To any subscriber for the fifth year we will furnish the back numbers of the first and second year for $2 25 each set, bound, or $1.25 each, unbound; and of the third and fourth years at $3.00 each, bound, or $2.00 unbound.

TESTIMONIALS.

As the fourth volume of the REVIEW will close soon, and we shall be asking our friends to renew their subscriptions, it may be well enough, by showing the estimation in which it is held by scientific men and periodicals in different parts of the country, to publish extracts from some of the encouraging letters and notices we have recently received. From them it will be observed that the REVIEW has met with favor not less in the East than in the West, and even in Europe it has found some readers of note who have been kind enough to express their appreciation of it and its management:

University of the State of Missouri,
Columbia, Mo., May 13, 1879.

THEO. S. CASE, Esq.:

MY DEAR SIR: I can but congratulate you on the excellence of your journal, and I will try and aid you with an occasional article,

Yours truly, G. C. SWALLOW.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. APRIL, 1881. NO. 12.

PHYSICS.

THE MAGNETIC SURVEY OF MISSOURI.

BY FRANCIS E. NIPHER, PROFESSOR OF PHYSICS IN WASHINGTON UNIVERSITY.

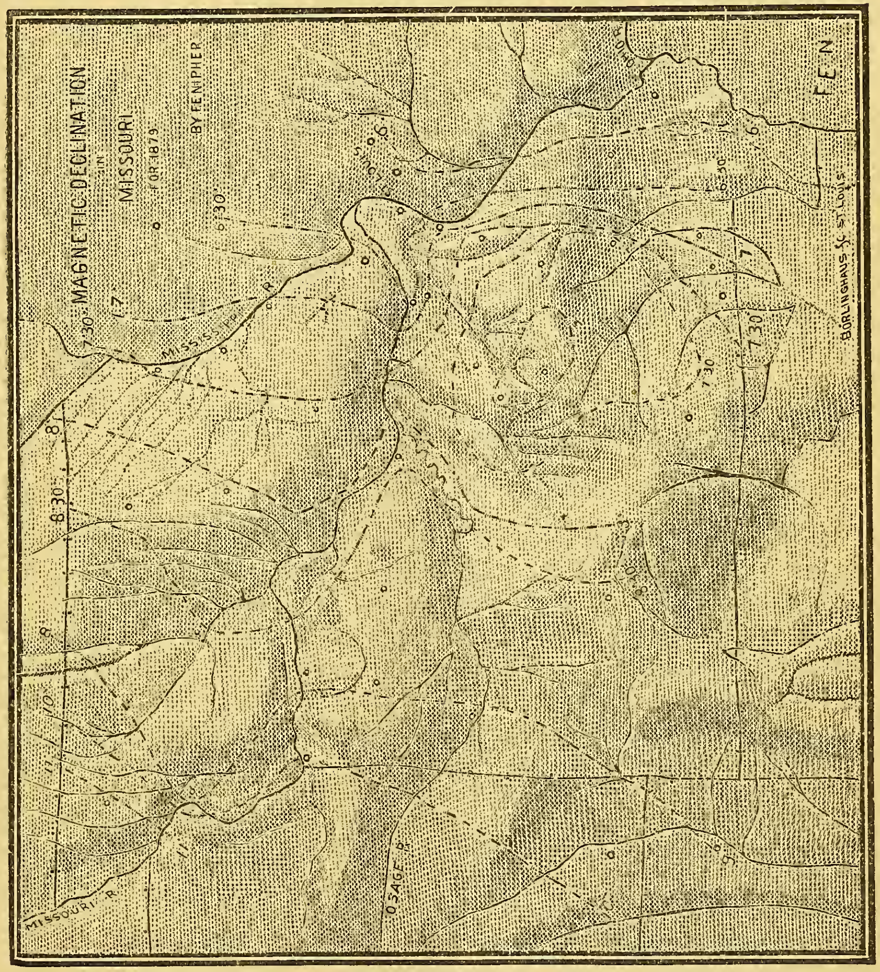
During the summer of 1878, the writer began a magnetic survey of Missouri. The object to be attained in such a survey is to determine the variation of the needle from due north, the dip of the dipping needle, and the intensity of the magnetic force, at properly selected localities in the State. In field work of this kind, it is not possible to attain the same accuracy that is realized in an observatory, as the mean daily position of the needle varies considerably (two minutes, and often more) from day to day. Hence observations are usually made for five or six days at each station, and the mean value is taken.

Believing that there was something to be learned in regard to local effects, it was our plan to establish a much greater number of stations of observation than is customary, and this made it necessary to spend correspondingly less time at the individual stations. This makes the station values less weighty, *severally*, but, by reason of their greater number, it was thought that the value of the work for general discussion would not be impaired. Hence, as a rule only one or two observations of variation were made at a station unless the result was an unexpected one, or unless we had reason to be dissatisfied with the work.

The apparatus used for determination of the variation (or declination) of the needle, consists of a transit of considerable magnifying power and provided with a good horizontal and vertical circle, reading to the half minute. This transit is mounted on a stand which also carries a small box in which the magnetic needle is hung upon a long silk fiber. This needle is of unusual form, being a small cylinder of steel, bored through from end to end. One end of this cylinder is stopped by a glass plate on which a fine scale is etched. In the other end is put a lens, the principal focus of which is at the scale. This magnet is hung in a stirrup attached to the fiber, in such a way that the scale is viewed through the lens, by means of the telescope. Hence, when the telescope is in focus for a star it will also be in focus for the scale of the magnet.

The observations are made as follows: The verniers of the horizontal scale of the instrument are set on 0°, and the telescope is turned on some distant object, as a church spire. This object is taken as the starting point for angles. The lower plate of the transit is then clamped, and the upper one loosened, so that when the telescope is turned, the scale reading of the vernier changes, showing the number of degrees swept over. The telescope is set on the pole-star when it is furthest east or west in its path around the pole. It is then only necessary to turn west or east a small angle, (which is given in the astronomical tables) and the instrument will be pointed due north. The vernier reading of due north being thus known, we know the number of degrees between the church spire and north. Hence, on any successive day, we could set the telescope on the spire, and turning this known number of degrees, the instrument would be pointed north. The telescope is then directed upon the magnet scale, and its reading taken. (Call this "A.") After this the magnet is turned upside down, so that the scale is seen inverted. (Call this reading "B.") The scale reading is generally different from the former. If the telescope is turned to the point on the magnet scale, midway between these scale readings "A" and "B," it is found that a reversal of the magnet does not change the reading. The telescope is then directed upon the magnetic axis, and lies in the magnetic meridian, being pointed to *magnetic north*. The angle between this direction and true north, read on the verniers of the horizontal circle, gives the desired variation. It is however well known that the position of the magnetic needle varies during the day, moving over an angle which is seldom less than four or five minutes, and which often amounts to a quarter of a degree or more. Hence, the *mean* position of the magnetic axis is determined for each day.

In order to see the results of such determinations it is customary to record the results reached at each station, at the proper places on a map of the region. Having done this, it is easy to drawn full degree lines through points having the same variation, just as we might draw an *isothermal* line through points having the same temperature. These lines in Missouri were found to be much more irregular than had been supposed, and it was easily seen that there was a marked relation between the contour of the surface and the position of the needle. It appears that the needle tends to set at right angles to river valleys, and that this tendency is inappreciable when the valleys are in general east and west or north and south, and that the tendency is greatest when the valley makes an angle of 45° with these directions. This points to a disturbance in the earth-current sheet, due to unequal conducting power in the moist valleys and on the dry hills. The matter, however, requires further investigation before it can be regarded as settled.



The woodcut which we present shows the topography of the State in a general way, and the lines of equal variations of the needle are drawn upon it. On the line marked 8°, the needle points everywhere 8° east of north, etc. This cut is after an elegant photograph by the artotype process, which will accompany the third annual report, in the Transactions of the St. Louis Academy of Science. It has also been printed in card form, with descriptive text for more general circulation. The artotype is taken from a plaster cast which was constructed to the scale of 20 miles to the inch, the elevations being exaggerated 200 times. In the photograph and wood cut, the horizontal scale has been changed to 60 miles to the inch.

The stations of observation are indicated in the cut by the small circles. Four of them have however been inadvertently omitted, viz: Carrollton, which lies on the 8° 30′ line; Glasgow, which is midway between the 8° and the 8° 30′ line; Columbia, which is just east of the 8° line, and Houston, which lies in the westward concavity of the 7° 30′ loop.

Those wishing to secure a larger and more accurate map, with these lines of equal variation upon it, can obtain the fine township map of R. A. Campbell, of St. Louis.

In conclusion it is perhaps proper to add that in the prosecution of this work we have received aid from many public spirited citizens of St. Louis and of the State. It having been found impossible to obtain from the Legislature the small appropriation necessary for finishing the survey, it is now at a stand. It is hardly reasonable to ask private citizens to carry on work which is clearly a matter for public enterprise.

THE KANSAS CITY ELECTRIC TIME BALL.

BY PROF. H. S. PRITCHETT, MORRISON OBSERVATORY.

The first time ball established in the United States was dropped from the dome of the Naval Observatory at Washington in 1855. It is still dropped at Washington mean noon, and has for a long time furnished the standard time for the city and the Departments of the Government. The apparatus employed and the method of dropping the ball are extremely simple. At five minutes before noon the ball is raised to the top of the staff on the old dome of the Observatory. The signal which drops it is made by hand by an assistant stationed in front of the mean time clock in the Observatory below. The ball when released drops upon the dome and thence rolls to the roof beneath.

The New York time ball, established in 1877, is dropped at New York noon by an electric signal, sent from the Naval Observatory at Washington. It was erected and is maintained by the Western Union Telegraph Company, and is dropped from their building on Broadway. At 11h. 55m. the ball it hoisted half-way up the staff on the tower of the building. At 11h. 58m. it is hoisted to its highest point, when it is about 250 feet above the street and can be well seen by the shipping at the New York and Brooklyn docks, and vessels in the bay and from suitable positions, is visible to a large part of the citizens of New York, Brooklyn, Hoboken and Jersey City.

The ball is 3ft. 6in. in diameter. It is really not a sphere but consists of circular pieces of metal joined together in such a way as to present the appearance of a solid ball when viewed from any direction.

If on account of wind the ball fails to drop at 12h. 0m. 0s., it is held till 12h. 5m. and then dropped. In such cases a small red flag is hoisted at 12h. 1m. and kept flying till 12h. 10m. This ball was for some time dropped by hand, but for the last year the dropping has been automatically effected by the clock at the Observatory. The working of the apparatus has been in the main satisfactory, and the ball has been dropped quite regularly, the failures being caused almost entirely by temporary breaks in the wire or other causes which could not be foreseen.

In the evening papers of the day and in the papers of the next morning a notice is regularly inserted, stating whether the ball dropped at correct time, and if not, its error, fast or slow. Many are at a loss to know how this correction is obtained. It is arrived at in the following manner: The time of the falling of the ball records itself automatically by electricity, near the standard clock of the Western Union Company in the building, the clock itself being regulated by the daily clock-signals from Washington. The difference between the time of falling of the ball and noon, as indicated by the clock, is thus obtained by a direct comparison. This assumes of course the accuracy of the clock and during a long continued season of cloudy weather, or in case of accident to the clock itself, the time might be somewhat in error, although the published correction might show but a few hundreths of a second. At present however, the Western Union has the benefit also of the Alleghany and Cambridge signals, for the regulation of this clock, so that even during the longest season of cloudy weather it is not probable that the clock could be much in error.

The Boston time ball, which is dropped at noon of Boston time, by means of the noon-time signal from the standard clock of the Harvard College Observatory, is placed upon the large building of the Equitable Life Assurance Company and was paid for and is now maintained by this company. The ball is of copper and weighs about 250 pounds. The machinery used in raising and controlling it is hence much more complicated and costly than in either of the cases before mentioned. The cost of ball and machinery was about $1200. The electric signal which drops it, is given by the clock itself, the ball having a drop of fifteen feet. The nearness of the Observatory, and the fact that the wire used is wholly under its control, give additional convenience and certainty in the dropping of this ball, and reduces the probability of accidents to a minimum, so that it is effected with great regularity and precision. Prof. Pickering, Director of the Observatory, reports that for the year ending Nov. 1st 1880, the ball was dropped exactly at noon on 355 days; on four other days at five minutes past noon, in accordance with the rule adopted; on four other days it was not dropped, leaving only three cases of inaccuracy of dropping.

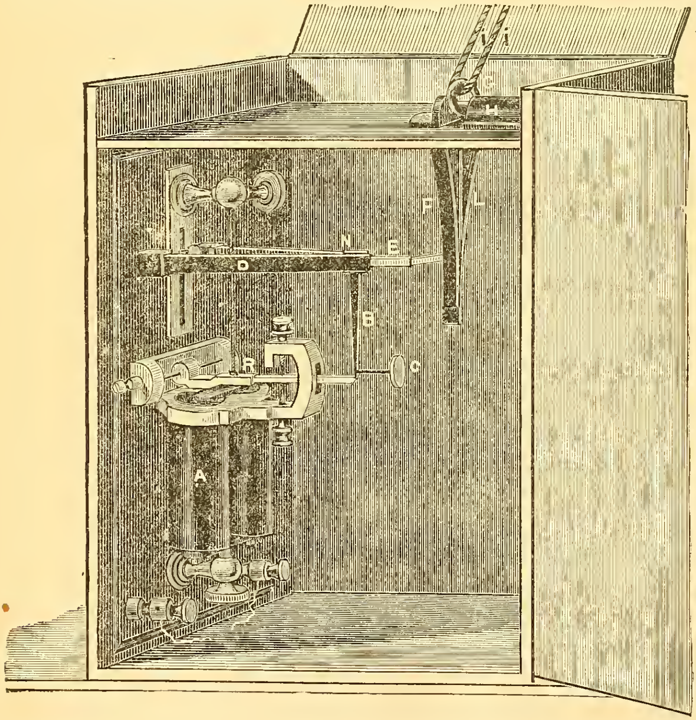
Quite recently a time ball has been established at Hartford, Conn., and dropped by the Winchester Observatory of Yale College.

The time ball recently erected at Kansas City, and which is dropped as a part of the time service of the Morrison Observatory, is the first attempt in this direction in the west. It was paid for chiefly by an appropriation of the City Council of that city. The site selected was the large building just erected by the Messrs. Bullene, Moores & Emery, on Delaware street. The ball when raised to the top of the staff is about 140 feet above the street, and is generally visible to the business portion of the city. The ball which passes over the staff, is simply a wire skeleton covered with canvas and painted black, and is about three feet in diameter. It was loaded on the inside with lead until it was found to drop instantly and without loss of time. It has a drop of about twenty-five feet and is slowed up as it reaches the bottom, and is received upon a set of tall springs surmounted by a stout cushion.

The apparatus used in dropping it is shown in the accompanying cut.

It is the arrangement of Mr. William F. Gardner, the skillful instrument maker at the Naval Observatory, who probably has had a wider experience in the construction of such apparatus than any one else in this country.

The machinery is simple and easily understood from the figure and answers every purpose. It is mounted in a box about two feet high and fifteen inches wide, which is firmly screwed to a table beneath. The cut shows it as it stands



ready for dropping the ball, which is drawn up to the top of the staff 5 minutes before noon.

The ropes (ii) which hold the ball in place are shown in the figure passing through a ring (G). The bolt which holds this ring is a continuation of the perpendicular piece (L). This is being constantly pressed back toward the right by a strong spring concealed under (H), and is only kept from flying back by the small arm (B), which fits into a notch on the end of (E). (A) in turn is kept from flying out to the left by the armature (R) of the magnet (A). As soon now as the circuit is closed at the Observatory at noon, this armature is instantly pulled down, the piece (B) flies out to the left, the ring is released and the ball drops. This has been found to work easily and without loss of time and can scarcely get out of order. The entire cost of mounting the ball and machinery was only about $120, and with this small amount it was necessary to use the utmost economy in the purchase of materials and apparatus. The apparatus thus briefly described, has been found to answer every purpose, and is probably as accurate as very much more costly apparatus would have been. Kansas City is about one hundred miles from the Observatory and except in cases of breaking of the wire, when the ball cannot be dropped at all, it is dropped within one or two-tenths of a second of correct time.

The discrepancy in the local time kept by different jewelers in the city, before the erection of the ball was astonishing, and led to endless confusion in business and travel.

On the first day the ball dropped this difference in extreme cases amounted to fifteen or twenty minutes, some being eight or ten minutes fast others as slow. The establishment of the time ball has brought about a uniformity never before known, and must soon make itself felt not only as a convenience, but a promoter of punctuality in business engagements.

From the daily clock-signals sent over the wires from the Observatory it will be easy to establish a similar time signal in any city in the west, which will take the necessary steps to procure these signals. An arrangement has been made also by which they may be distributed to jewelers, and clock-makers, and manufacturing establishments in the larger cities.

The people at Kansas City are indebted to the officers of the Western Union Telegraph Company, for many courtesies in connection with the establishment and maintenance of this time ball. Mr. W. K. Morly, Supt. of Telegraph on the Chicago & Alton Railroad, kindly allows the use of a wire in dropping the ball, while at Kansas City Mr. M. D. Wood, Superintendent, and Mr. W. H. Woodring, chief operator, have gratuitously given their services each day at the time when the ball is dropped. Without their cordial cooperation, the success attained would have been impossible.

DESTRUCTION OF FORESTS.

T. L. LEWIS, BOLIVAR, MO.

The indifference of our people to forestry is criminal. It has been estimated that there are but six states east of the Rocky Mountains which have a surplus of timber; yet, nearly all are denuding their lands and shipping wood, ties and lumber. Strike a line through Minnesota, Iowa, Kansas, and Texas; or take longitude 80° west of Washington, and the eastern side contains all the timber, while the western is almost one boundless desert of treeless prairie. California is far above an average, yet only about one-twentieth part is timbered. This western world of prairie is now teeming with active life, and must soon be the home of millions, with their shops, factories, railroads, etc., etc. It becomes then a practical question—will the supply meet the demands under our present reckless system of the wanton destruction of our forest? It is an impossibility unless the timbered states legislate wisely on this matter, and the prairie states follow the example of Kansas in the cultivation of forests. Let us look at a few facts.

It has been estimated that 30,000,000 of our people use wood as fuel, consuming 100,000,000 cords annually. We have about 90,000 miles of railroads consuming 400,000 acres of timber every year. Steamboats, factories, brick yards, etc., consume annually about 35,000,000 cords. And more than 70,000 factories of wood articles also consume about $410,000,000 of timber every year. The total forest cutting annually is estimated at nearly one thousand millions of dollars. Again we ask, at this enormous and wholesale rate of forest destruction, can the supply meet the demands of the rising west and still provide for the wants of the east, unless our forests are protected by law?

HISTORICAL NOTES.

THE SPANISH EXPEDITION TO MISSOURI IN 1719.

JOHN P. JONES, KEYTESVILLE, MO.

The Memoirs, Historical Journals, and other writings in which the French have narrated the events that occured during their occupation of the vast territory which they called Louisiana, contained frequent mention of an expedition which left Santa Fe, N. M., about the year 1719 for the purpose of establishing a military post in the upper Mississippi Valley as a barrier to the further encroachments of the French in that direction. One of the objects aimed at by the Spanish authorities in sending out this expedition is said to have been the destruction of the tribe of Indians known as the Missouris, who were supposed to be especially under the influence of the French; intending by the destruction of this nation to intimidate those of the surrounding localities and make them more inclined to ally themselves with the Spaniards than with the French. The account of this expedition most generally accounted as correct during the last century, is the one given in Dumont's Historic Memoirs of Louisiana.* Dumont was one of a party ascending the Arkansas river in search of a supposed mass of emeralds, and says: "There was more than half a league to traverse to gain the other bank of the river, and our people were no sooner arrived than they found there a party of Missouris, sent to M. de la Harpe † by M. de Bienville § then Com-

*Memoires Historiques sur La Louisiana, 2 Vols., Paris, 1753. The author was a Lieutenant in the French army and lived twenty-two years in the colony. His work has never been translated, though French in his Historical Collections of Louisiana prints a portion of one volume, and Du Pratz, in his work makes large drafts on hoth.

† Bernard de la Harpe, a French officer who was very active under Bienville during the first years of the colony. In 1719 he built a fort on Red River. In 1720 surveyed a portion of the coast of Texas and took possession of the country near the Bay of St. Bernard. He received a concession of lands on the Arkansas. At the date mentioned by Dumont he was the leader of an expedition sent to explore the Arkansas River. He wrote a work called "Historical Journal of the Establishment of the French in Louisiana," which remained in manuscript until the year 1831, when it was printed in French.

§ The second governor of Louisiana and the "Father of the Colony." His career is a matter of history.

mandant General at Louisiana, to deliver orders to the former. Consequently they gave the signal ordered and our other two canoes having crossed the river. the savages gave to our commandant the letters of M. de Bienville, in which he informed him that the Spaniards had sent out a detachment from New Mexico to go to the Missouris and to establish a post in that country. In the same packet there was a map drawn by a Spanish geographer, of the route which the caravan have held from Santa Fe, and there we noticed a large lake which they had crossed and to which they gave the name of Red Sea. I have scarcely a doubt that this is the lake which M. de Lisle ‡ calls in his map the Sea of the West. The success of this expedition was very calamitous to the Spaniards. Their caravan was composed of fifteen hundred people, men, women and soldiers, having with them a Jacobin for a chaplain, and bringing with them a great number of horses and cattle, according to the custom of this nation to forget nothing that might be necessary for a settlement. Their design was to destroy the Missouris, and to seize upon their country, and with this intention they had resolved to go first to the Osages, a neighboring nation, enemies of the Missouris, to form an alliance with them and to engage them in theit behalf for the execution of their plan. But, perhaps the map which guided them was not correct, or they had not exactly followed it; it chanced that instead of going to the Osages whom they sought, they fell, without knowing it, in a village of the Missouris, where the Spanish commander, presenting himself to the great chief to offer him the calumet, made him understand through his interpreter, believing he was speaking to the Osage chief, that they were enemies of the Missouris, that they come to destroy them, to make their women and children slaves and to take possession of their country; consequently he begged that they would be willing to form an alliance with them, against a nation whom they regarded as their enemy, and to second them in this enterprise, promising to recompense them liberally for the service rendered, and to be always their friend in the future. Upon this discourse the Missouri chief understood perfectly the mistakes. He dissimulated and thanked the Spaniards for the confidence they had in his nation; he consented to form an alliance with them against the Missouris and to join them with all his forces to destroy them, but he represented that his people were not armed and that they dare not expose themselves without arms in such an enterprise. Deceived by so favorable a reception, the Spaniards fell into the trap laid for them; they received with ceremony, in the little camp they had formed on their arrival, the calumet which the great chief of the Missouris presented to the Spanish com mander. The alliance war sworn to by both parties, they agreed upon a day for the execution of the plan which they meditated, and the Spaniards furnished the savages with all the munitions which they thought were needed. After this ceremony both parties gave themselves up equally to joy and good cheer. At the end of three days two thousand savages were armed and in the midst of dances and amusements, each nation thought of nothing but the execution of his design.

‡ William de Lisle, an officer of the French army whose maps of Louisiana were very correct for the time of their publication.

It was the evening before their departure upon their concerted expedition, and the Spaniards had retired to their camps as usual when the great chief of the Missouris, having assembled his warriors, declared to them his intentions and exhorted them to deal treacherously with these strangers, who were come to their home only with the design of destroying them. At daybreak the savages divided into several bands, fell on the Spaniards, who expected nothing of the kind, and in less than a quarter of an hour all the caravan were murdered. No one escaped from the massacre except the chaplain, whom the barbarians saved because of his dress: at the same time they took possession of all the merchandise and other effects which they found in their camp. The Spaniards had brought with them as I have said a certain number of horses, and as the savages were ignorant of the use made of these animals, they took pleasure in making the Jacobin whom they had saved and who had become their slave, mount them. The priest gave them this amusement almost every day for the five or six months that he remained in their village, without any of them daring to imitate him. Tired at last of his slavery and regarding the lack of daring in these barbarians as a means that Providence had offered him to regain his liberty, he made secret all the provisions possible for him to make and which he believed necessary to his plan. At last having chosen the best horse and having mounted him, after having performed several of his exploits before the savages, while they were all occupied with his maneuvers, he spurred up and disappeared from their sight, taking the road to Mexico, where doubtless he arrived. Sometime after a party of these same Missouris went to the Illinois with the intention of presenting the calumet to the French general who was in command at that place"

"It was the Sieur de Boisbriant* who in the visit these savages made him, was not a little surprised to see some of them covered with sarcerdotal vestments, others wearing stoles and some others wearing a chalice cover hanging on their neck, or a chalice in their hands. After informing himself on the subject of this masquerade he ransomed from the savages the sarcerdotal habiliments, profaned by these barbarians. It was from them that he had the map of which I have spoken, which they found among the possessions of the Spaniards. He gave it immediately to the general in command of the country, with all the details of this adventure, and it was from the latter that we learn the particulars which I have just related."

It is difficult to say how much of the foregoing is truth and how much romance; nearly every writer of French annals of Louisiana gave credence to the story in almost the precise form given by Dumont. Several English compilers also adopted it and it seems to have been generally received as the truth. M. Bossu † in his book on Louisiana follows the story about as we have given it,

* Pierce Duque Boisbriant, a cousin of Bienville, who arrived in the colony in 1699, was a major and knight of the Blue Ribbon. Was for a long period in command at Biloxi and led several expeditions against the neighboring Indian tribes. Left Mobile in October 1718 for the Illinois country where he had been appointed as commandant of the post In 1721 he received the cross of St. Louis, and in 1724 was appointed governor *ad interim*, Bienville being suspended. In 1726, on the downfall of the Bienville regime, he sailed for France.

† Travels through that part of North America called Louisiana, by M. Bossu, captain in the French Marine. 2 Vols., London 1771.

but adds additional particulars in regard to the visit of the Missouris to the French commandant at the Illinois, describing the procession as they marched and danced, with the ornaments of the chapel suspended about their necks, and that of a horse they had brought with them.

Du Pratz § in his history of Louisiana, gives a condensed account of the expedition similar to the foregoing and adds, speaking of the visit of the Missouris to the Illinois, "They had brought the map which had so disastrously led the Spaniards. After having having examined it, it appears to me better suited for the west of our colony toward them than for the country in which we are interested. From this map it would seem that we should bend the Red and Arkansas rivers as I have said in its place, and place the source of the Missouri more to the west than our geographers do."

Dumont, as I have shown, also writes of the same map and the fact that the expedition had with them the map of the country, would seem to give weight to the belief entertained by the French at the time, that the enterprise was undertaken by the Spaniards, with a purpose which agreed in general with the story of their intentions as told by the Missouris.

Charlevoix,* who traveled from Quebec to New Orleans in the year 1721, says in one of his letters to the Duchess of Lesdiguieres, dated at Kaskaskia, July 21, 1721: "About two years ago some Spaniards, who came, as they say, from New Mexico, intending to get into the country of the Illinois and drive the French from thence, whom they saw with extreme jealousy approach so near the Missouri, came down the river and attacked two villages of the Octotas,‡ who are allies of the Ayouez,† and from whom it is also said they are derived. As the savages had no fire-arms and were surprised, the Spaniards made an easy conquest and killed a great many of them. A third village, which was not far off from the other two, being informed of what had passed and not doubting but these conquerors would attack them, laid an ambush into which the Spanirds heedlessly fell. Others say that the savages having heard that the enemy were almost all drunk and fast asleep, fell upon them in the night. However it was, it is certain the greatest part of them were killed. There were in the party two almoners; one of them was killed directly and the other got away to the Missourites, who took him prisoner, but he escaped from them very dextrously. He had a very fine horse and the Missourites took pleasure in seeing him ride it, which he did very skillfully. He took advantage of their curiosity to get out of their hands. One day as he was prancing and exercising his horse before them, he got a little distance from them insensibly; then suddenly clapping spurs to his horse he was soon out of sight."

Charlevoix also says that he obtained the spur of the Almoner that was killed and that the Indians had his breviary. The story of the priest and the manner

§ History of Louisiana, Etc., by M. Le Page, Du Pratz Paris 1758. The author was for many years a government factor in the Province of Louisiana, and on his return to France published the above work.

*The celebrated Jesuit father, author of "The History of New France.' Journal of a Voyage to N. A. Leters to the Duchess, etc.

‡Otoes. †Iowas.

of his escape seem to be nearly as well authenticated as that of the map. Charlevoix writes from near the place where the expedition met its fate and within two years of the time it left Santa Fe, and the probabilities are that he was at the Illinois when the Missouris came over and told the commandant their story. Besides the spur and breviary, he mentions that one Indian had a pot of ointment which he prized very highly. It will be seen that he locates the scene of disaster to the Spaniards as among the Otoes. This tribe were of the same family as the Missouris and spoke nearly the same language; seventy-five years later, when the Missouris were nearly destroyed by tribes from the north, the remnant found shelter and home with the Otoes and finally became merged in this tribe. It is possible that the Spaniards did attack the two villages of Otoes, and that they fled down the river to their allies, the Missouris, who ambushed the Spaniards and destroyed them.

De la Harpe, in his Historical Journal of the Establishment of the French in Louisiana, says, under the date of April 24, 1721: "M. de Bois Briant writes from the Illinois that the Spaniards, to the number of 300 men, were come out from Santa Fe, capital of New Mexico, with the design of taking possession of the lands of this colony. Of these 300 men only 70 had put the enterprise in execution and passed through several savage nations, guided by the Padoucas, who, instead of leading them east quarter northeast, went too far to the north, so that they arrived on the banks of the Cances* river near the Missouri; there they had met the nations Octotata and Passinaha,† who had killed all of them except one friar, who had been saved on his horse."

It will be observed that the author just quoted gives the report of the commandant at the Illinois, and that he fixes the number comprising the expedition at 70 men. This I believe to be much nearer the truth than the number stated by Dumont. Such an expedition could be easily destroyed by any of the tribes on the Missouri river at that time.

Stoddard,‡ in his Historical Sketches of Louisiana, writing of the expedition, says it was intended to make allies of the Pawnees and obtain their assistance in destroying the Missouris, and on this point observes: "Various writers assert that these colonists aimed to find the Osage villages, but the records of Santa Fé authorize the statement we have given." If such records were in existence when Mr. Stoddard wrote, they are not to be found now, as I have had them searched for diligently. The extracts I have cited give in substance what the early French historians and annalists wrote concerning the expedition, and while it must be admitted they vary, still there is sufficient evidence for us to believe that the Spaniards at Santa Fé fitted out and dispatched a body of men, with instructions to lay the foundation of what was hoped would be an obstacle to the spread of French dominion west of the Mississippi. That this expedition was destroyed

*Kansas.

†Pana of Marquette; Panys of Perot; Panis of Charlevoix; Panismahas of the Jesuit letters, and Pawnees of the present time.

‡Sketches Historical and Descriptive of Louisiana. By Major Amos Stoddard. Philadelphia, 1812. The author was the first governor of the colony of Upper Louisiana after the cession of Louisiana to the U. S.

by the Indians, is also probable, and the locality where it met its fate should be an object of interest to the investigators of our early history. If destroyed by the Otoes and Pawnees, it is probable that the destruction took place not much west of Kansas City; if by the Missouris, it was not far from the mouth of Grand River, as the old village of the Missouris was but a few miles east of where that river empties into the Missouri, and the counties of Howard and Chariton are prolific in Indian remains. At the date of this expedition the French were reaching out toward the Spanish possessions in a manner calculated to excite the jealousy of the latter nation. De la Harpe, under the authority of Gov. Bienville, had built a fort and formed a settlement on Red River, and, in correspondence with the Spanish commandant at Assinais, had laid claim on behalf of the French to the province of Texas, basing his claim on the fort built by La Salle in 1685. Dumont, another French officer, was exploring the Arkansas, whose waters extended nearly to Santa Fe, while the French at the Illinois post were considering the possibility of a route to the Pacific Ocean by way of the Missouri. In attempting to confine the French to the east bank of the Mississippi, the Spaniards were but trying to guard a territory which they believed to be rightfully their own, and which, in the year 1762, was relinquished to them by the French.

THE MOQUIS.

In the history of the aboriginal races of this country, little is said regarding the Moquis, a branch of the Pueblos, living, where possibly they have lived for a thousand years, in a rocky stronghold in a sandy desert of Arizona. This people number about two thousand five hundred, and occupy six villages, with houses built of stone, cemented with sand and clay. These villages, says Dr. Loew, of Wheeler's surveying expedition, are built on the tops of four sandstone mesas, which are separated from each other about eight miles. They occupy the entire width of the mesas, and, standing immediately before the houses, one may look vertically down a depth of three hundred feet. In many places the sides of the mesas are terraced, being used as sheep corrals. In appearance the Moquis come rather nearer to the Caucasian than the rest of his race. These Indians are well clad, and the females especially so. Indian corn is the principal food—the sheep are raised for their wool rather than for the table. From the wool a good blanket is made. The seed corn is planted about one and a half feet from the surface, at which depth sufficient moisture is found to develop and sustain the plant. The Moquis have neither church or any other place of worship, and the Spanish Jesuits were unable to gain a foothold among them.

GEOLOGY AND PALÆONTOLOGY.

THE JUDITH RIVER GROUP.

BY CHAS. H. STERNBERG.

[*Read in part before the Kansas Academy of Science.*]

The upper Missouri cuts its way for hundreds of miles through the great shale beds of the Fort Pierre group: they contain quantities of the salts of soda and magnesia, and all the waters flowing through them are strongly impregnated with these salts. On the top of this group lie the soft buff-colored sandstone of Cretaceous No. 5., or Fox Hills group. So far as I have examined, they are destitute of fossils. Near the mouth of the Judith river and for one hundred and fifty miles down the Missouri, the summits of the surrounding hills are covered with the rocks of Cretaceous No. 6, or the Judith river group. They consist of an upper and lower stratum of brown sandstone, interlaid with beds of various colored clays, fresh water *unios* and Lignites. These beds were first discovered and described by Dr. Hayden, to whose untiring energy we are indebted for our knowledge of the stratagraphy and geology of the Northwest. He was driven out of the country by Blackfeet Indians, and was only able to save some teeth and turtle shells. These have been described by Dr. Leidy, as follows:

Triodon formosus, and *Amblysodon horridus*, Carnivorous Dinosaurs and *Paleocincus costatus*, and *Trachodon mirabilis*. Herbivorous Dinosaurs of the *Testudinata* are *Trionyx foveatus*, *Compsemys vetus*, and *Emys obscurus*. These specimens were prophetic of a rich store in wait for the fortunate explorer who would be able to make a collection in this interesting country and carry it away.

Ever since Hayden's explorations this country has been looked to with interest by scientific men. In 1876 Prof. Cope resolved to go to the Juidth river, and he thought he could do so safely, as the Sioux were south fighting the soldiers. I joined the Professor at Omaha, in August. At Ogden we took the Northern Utah Railroad for Franklin, Idaho, where a journey by stage of 600 miles awaited us. Through Idaho the alkaline dust drove in great clouds, and nearly blinded us: we hailed the mountains with delight. Only persons who have made long journeys by stage can know of the discomforts we endured. We outfitted at Fort Bentons the head of navigation on the Missouri. Our party consisted of five men. One to act as guide, one as cook, the other three including Prof. Cope, were collectors. We traveled down the Missouri one hundred and twenty miles to the Judith River and went into camp at Dog Creek where our field work began.

The beds of the Judith River group lay on the summits of hills or in synclinal valleys near the top. Our first work every morning was to climb to the summits of the Bad Lands, about 1500 feet, over beds of black shale. At first we only discovered loose bones, teeth and turtle shells. We had hard work clinging to the almost perpendicular bluffs, where a misstep would hurl us into a cañon 1500 feet deep. We had often to cut niches for our feet with hand picks, which we always carried, as without them we would have been unable to travel. The surface was covered with loose angular fragments of cherty rock, that rolled under our feet. One great hardship we had to endure, was the lack of drinking water during the day, as all that was found in the Bad Lands was strongly impregnated with alkaline salts. Another hardship was the presence of great swarms of small gnats that got under our hat rims, and inflicted wounds that poisoned the flesh. But our toils were well rewarded, as we were able to add some forty new species of strange animal life to science; and I think that of all the singular and unique animals that have peopled our earth, some that we discovered were the strangest. They were great land saurians or *Dinosaurs*. They were the most numerous of the animal remains we collected. Some of them reached to the enormous height of twenty-eight feet. They walked on their hind limbs, which were strong and pillar-like. An immense tail helped support their ponderous weight while feeding on the tender branches and leaves of trees. Their front limbs were short and armed with powerful claws for grasping. In each jaw were three rows of teeth, and below each old tooth was a hollow groove containing five young ones. As fast as one row wore out another took its place. We found thousands of these cast-off crowns. Of course I have been speaking of the Herbivorous or plant eaters. The Carnivorous *Dinosaurs* were lighter and more elegantly built for springing on the huge plant eaters. They were armed with a single row in each jaw, of long re-curved teeth, with serrate edges. Young teeth were ready to take the place of old ones, when they were broken or worn out.

The *Dinosaurs* resembles the bird in many parts of its structure. They have but one occipital condyle. Their bones are light and hollow. They also resemble the mammals by their habits, and the structure of the pelvis and pectoral arches. But on account of many reptilian characters, they are classed in that division of vertebrate life. Turtles were abundant, and were usually soft-shelled, and other fresh water species. The shells were often curiously marked with elevated or depressed lines, or punctures. Among the fishes *Ganoid*, or the *Lepidosteus*, that ancient and persistent type, were common. One peculiar species I discovered of the shark family, had six-sided teeth, with a line down the long diameter, with dark-colored enamel on one side and light on the other. They were arranged in the roof and floor of the mouth, like bricks in a pavement, and were used as a mill for grinding up shells. Prof. Cope calls it *Myledaphus bipartita*. *Batrachia* were abundant. No mammals were found, though a number of geologists have thought these beds to be of Tertiary age. The explorations of Prof. Cope, have, I trust, proved conclusively that they are Cretaceous. The upper beds are covered in places with oyster shells, showing that at the close of the Cretaceous the sea covered the formation. Large deposits of lignite are found both in this and the Fort Pierre group. There are also great quantities of fossil wood scattered through the formation.

Near Cow Island, six miles down the Missouri, we found three nearly perfect skeletons, the femur of one specimen being five feet in length. While we were camped on Dog creek Prof. Cope went ahead to Cow Island, and sent word for us to follow with outfit. This was no easy job, as we had to get our wagon to the top of the Bad Lands over the steep slides of the Ft. Pierre group. We had made a bridle path to the summit, and following this we made the venture. After unloading the wagon it took four horses to haul it within about four hundred feet of the summit. Here the slides were very steep and the bridle path led along the side. Our teamster refused to drive any further so Mr. Isaac took his place, after taking off the lead horses. I went ahead on horse-back to encourage the team, but before we had gone ten yards the horses' feet slipped from under them, and taking the wagon with them, they made three complete summersaults and landed on their feet all right, with the wagon in its proper position. The reader can easily imagine the peals of laughter that greeted this exploit. Our next performance met with more success. We took the horses to the top of the hill and tied our picket ropes together, and fastened one end to the hind axle, the other to the doubletrees, and the team hauled our wagon safe and sound to level ground, though all hands had to hold down on the upper sills of the wagon box to prevent another overturning.

When we reached the uplands a magnificent view burst upon us. To the south lay the Judith river and Medicine Bow Mountains, while to the north were the Little Rockies and Bear Paw Mountains, and far below us the waters of the great Missouri looked like a silver thread. We found ourselves on a broad, level prairie, covered with bunch grass, while at the heads of ravines that ran into the Missouri were groves of pines. The country for miles had been dug up by grizzly bears in search of artichokes. We often crossed heavy elk and deer trails. At the head of Dog creek we saw a number of buffaloes and deer; the country seems to be full of game, and is the favorite hunting grounds of the Crow and Sioux Indians.

When we reached Cow island we proposed to go into camp on the Missouri; the only place where it was possible to get down the bluffs with a wagon was very steep. However, it is easier to get down a steep place than up it. A kick sent our rolls of blankets on their way, and a couple of ropes tied to the hind axle and held by a half-hitch around a tree, kept everything steady. A man at the tongue guided our wagon until it reached level ground, of course the ropes were let out as the wagon descended by its own weight. Night had overtaken us when we reached our camping ground, which we found covered with cactus. They were dug away from a place large enough for our tent and fire. My first thought on awaking the next morning, after examining our camping ground, was, How in the world will we ever get out of this place? We were in a small valley containing five or six acres, the bluffs extended on either side to the river, and behind us was the place we had let the wagon down, and I knew that unless it was taken to pieces and packed on horses, it never could be taken up the way it came down. But as the Professor assured me he would find a way out, I was satisfied, as I had a great deal of faith in his ability to accomplish almost anything.

We were camped three miles below Cow island, and when we were ready to move, the Professor purchased an old scow, on which we loaded our outfit, swam our horses over and paddled across. Then as the shore was low on that side, we turned it into a tow-path, hitching a horse to our scow, and after a great deal of labor we found ourselves at the boat landing of Cow island. The next day Prof. Cope took the steamer for Bismarck and Mr. Isaac and myself were left to complete the explorations; we remained until November, when hearing that the Indians were returning, and as cold weather had set in, we returned to Fort Benton, after a disagreeable joueney on account of snow. W e saw great droves of antelope, deer and some buffalo. I suffered a good deal on my return trip by stage, but after the troubles were over and I was safe within the bounds of civilization, I could but congratulate myself with the feeling that I had helped advance the interests of Science. The discomforts of the explorer are soon forgotten in the results accomplished. I will give my readers a partial list of the species discovered, to show the results of the expedition. All are new except those already described, and have been described by Prof. Cope in Bulletin of U. S. Survey.

REPTILIA.

DINOSAURIA.

Gonipoda.
Triodon formosus.
Lælaps cristatus.
L. falculus.
L. lavifrons.
L. hazenianus.
L. incrassatus.
Amblysodon horridus.
A. lateralis.
Zapsolis abradeus.
Paronychodon lacustris.

ORTHOPODA.

Paleocincus costatus.
Dysganus peiganus.
D. bicarinatus.
D. haydenianus.
Dichocrinus pentagonus.
D. perangulatus.
D. calamarius.
Trachodon mirabilis.
Monoclinus crassus.

CROCODILIA.

PROCŒLIA.

Crocodilus humilis. (*Leidy.*)

TESTUDINATA.

CRYPODIRA.

Trionyx foveatus.
T vagans.
T, mammilaris.
Plastomenus punctulatus.
Polythorax missouriensis.
Compsemys victus.

ELASMOBRANCHII. (L. L.)

Myledaphus bipartita.
Hedronchus sternbergii.

GEOLOGICAL CLIMATES.

4 ADDISON GARDENS,
KENSINGTON, 11th February, 1881.

EDITOR REVIEW:—I venture to send you a number of *Nature*, with a letter of mine, which I have thought it necessary to write after the perusal of a controversy that has been carried on for some weeks past, between two distinguished men, namely, Mr. Wallace, author of the Malay Archipelago, and Island Life, etc., and the Rev'd Samuel Haughton, Professor of Geology in the University of Dublin, on "Geological Climates," the former maintaining that were there certain depressions, or rather submergences of portions of land, tropical currents would flow Northward through the openings, thaw all the Polar ice, and make the Arctic climate almost if not wholly temperate.

Prof. Haughton takes quite an opposite view, and thinks the ice-cap at or near the Pole may be hundreds of feet thick, and that the Arctic current flowing South would interfere materially with the heating influence of the tropical stream.

So much is required to explain the meaning of my letter, which, from fearing it would occupy too much space, I did not make so explanatory as I could have wished. Yours Truly, JOHN RAE.

"I have read with much interest and attention the letters that have appeared in recent numbers of *Nature* on the subject of "geological climates," and although it must appear presumptuous on my part to do so, I shall endeavor to show that each of the distinguished writers of these letters may be somewhat in error on at least one point, which—if I am right— must materially affect the correctness of the conclusions they have come to.

I think that Mr. Wallace, whilst very justly giving the Gulf Stream and other currents, which *might* exist were certain lands submerged, credit for great influence in ameliorating the rigor of climate, does not take into sufficient consideration the fact that the waters of the Gulf Stream, although warmer, are, in consequence of holding much more salt in solution, heavier than the colder and less saline Arctic current.

Some experiments show, as clearly as anything done on a very small scale can, that two waters brought as nearly as possible to the conditions of the Gulf Stream and the Arctic current do not mingle when simultaneously poured into a long narrow glass trough; the Arctic water invariably taking its place on the surface.

Supposing then that these two currents meet somewhere about latitude 80° or 81° N., the Arctic water flowing south—if my experiments are of any value—will retain its position on the surface and the warm current pass underneath, and thus lose all its heat and influence on the air over a Polar area about 1000 geographical miles or more in diameter.

We can have no stronger example of this effect of difference of density of ocean water than is shown by the two currents *in* and *out* of the Mediterranean Sea.

In *Nature*, vol. xxiii. p, 242, Prof. Haughton says, "The thickness of this ideal ice-cap at the Pole is unknown, but, from what we know of the Palæocrystic ice of Banks Land and Grinnel Land, *must be measured by hundreds of feet, and its mean temperature must be at least 20° F. below the freezing point of water.*"

With regard to both the above assumptions—which are in italics—I must beg to disagree entirely with the learned Professor. He appears to consider the so-called Palæocrystic ice as the normal state of the ice at and near the Pole, and as a natural growth by the gradual freezings or increase of a single floe during a series of years; whereas I am of opinion that this mis-called Palæocrystic ice is the result of a number of floes being forced over and under each other by immense pressure caused by gales of wind and currents.

The western and northern shores of Banks and Grinnel Lands are peculiarly well suited for the formation of such ice heaps; as they are exposed to the full force of the prevailing north and northwest storms, which pile up the ice in a wonderful manner on these shores and others similarly placed, for a distance of miles seaward. The whole of the west shore of Melville Peninsula is so lined with rough ice of this kind that sledging is impossible.

It will wholly depend upon the form of land—if any—at or near the Pole, whether or not any floebergs are there. If there is no land it is probable there will be few or none, as the ice will meet with no great obstruction, as it is driven by winds and currents.

I have no authorities by me that give the thickness of ice formed in one season at or near the winter quarters of any of the Arctic expeditions, except my own in 1853-4 at Repulse Bay, latitude 66° 32′ north.

The measurements of the ice—taken at some distance out in the bay, where there was very little snow—and the mean temperature of the air are given.

1853	Ice thickness	Increase		Monthly Mean Temp. F.
December 20	...4 feet 7 inches...	—		...24°·5 below zero
1854				
January 24	...5 feet 9 inches	...14	in 35 days	...30°·6 " "
February 25	...7 feet ¾ "	...16	in 32 days	...34°·9 " "
April 25	...8 ft 1½ "	...12¾	in 59 days	... 8°·5 " "
May 25	...8 ft 1¼ "	...none	30 days	...24° above zero

The above table shows that the ice ceased to increase in thickness some time between April 25 and May 25. after which it decreased rapidly; but I was unable to decide what proportion of this decrease was due to thaw and evaporation from the surface, and what amount from the lower part of the floe that was under water; no doubt by far the greater effect was produced by the first two causes.

Eight feet may perhaps be considered a fair or rather a high average of one winter's formation of new ice (not increase of an old floe) over the whole of the Arctic Sea; because Repulse Bay, although in a comparatively low latitude, was particularly favorable for ice-formation, there being no currents of any consequence. Where there are currents, one year's ice does not exceed three or four feet.

The winter's ice of 1875-6 at Discovery Bay, in latitude 81° 40′ N., did not exceed, if I remember correctly, six feet in thickness.

Even were these great compound floes, called Palæocrystic ice, found at or near the Pole, and of only the same thickness as those seen at Grinnel Land—instead of "hundreds of feet"—they would not probably have nearly so low an average temperature all the year round as 20° F. below the freezing point of water, because only one-sixth of their mass would be exposed to very low temperature for about six months of the year, the surface being during that time protected by a more or less thick covering of snow, whilst at least five-sixths of their bulk was under water, having a temperature for the whole twelve months of or about the freezing point of the sea. The question is, how far the very low temperature of an Arctic winter penetrates a mass of, say sixty feet of ice, the surface of which is covered with a foot of snow, and fifty feet or five-sixths under water of a temperature at or above the freezing point of the sea?

From my experience on a much smaller scale, I do not believe that the atmospheric cold would, under the circumstances mentioned, penetrate to the lower surface of ice sixty feet thick; and if it does not do so there would be no increase to its thickness during the winter.

An excellent example of formation of Palæocrystic ice, or floe-berg is afforded by the experience of the Austro-Hungarian Expedition under Weyprecht and Payer in the Barentz Sea in 1873-4. Their ship was lifted high out of the water by the pressure of the floes, which were forced over and under each other to a great thickness and extent in a few days.

The ship and her crew were helplessly drifted about for many months, during which the floes were frozen together into one solid mass, and the inequalities of the surface in a great measure filled up with snow-drift. JOHN RAE.

4 Addison Gardens, January 29.

GEOGRAPHICAL NOTES.

HEATH'S DISCOVERIES IN SOUTH AMERICA.

PROF. JOHN D. PARKER, KANSAS CITY, MO.

Since the death of Prof. Orton in South America, his assistant, Dr. Ivon D. Heath, and his brother, Dr. E. R. Heath, have both taken a deep interest in completing the unfinished work of that expedition. Prof. Orton had formed the purpose of conducting his expedition through the unexplored portion of the Beni river, over which there has always hung such an uncertainty and superstitious fear. But just before he reached this portion of his journey, the soldiers, whom he had hired and paid in advance for his whole expedition, intimidated by superstitious fear, suddenly presented their bayonets at the breast of Prof. Orton, refused to go any further and returned home. Prof. Orton was, therefore, compelled to abandon his expedition, and returned almost heart-broken to die of weariness and disappointment on the legendary lake of Titicaca.

About three years ago, Dr. E. R. Heath returned to South America to complete, if possible, Prof. Orton's work, and explore this unknown region, the *terra incognita* of South America. It was hoped that some Geographical Society would aid in this important work, but while plans were being laid to secure material assistance, Dr. E. R. Heath undertook and solved the problem himself.

On December 28, 1880, Dr. Heath, of Wyandotte, Kansas, received a letter hastily written by his brother, dated Reyes, Bolivia, on the river Beni, Aug. 3, 1880, on the day of his embarkation for the rubber camps and the unknown country further below. He wrote that he was just setting out to explore this unknown region, and that three months would tell the tale of his success or defeat.

On March 19th, Dr. Ivon D. Heath received another letter from his brother in South America, announcing that his expedition had proved a complete success. The following extract will be interesting from this letter, which is dated Reyes, Bolivia, Dec. 20, 1880:

"The question of the Beni is solved. This work of Professor Orton is finished. I made the trip from Cabinas (rubber camps on the Madidi) in a canoe with two Indians. I left Cabinas September 27, and, after delays from sickness of my men, at 8 A. M., October 8th, discovered a new river entering from the south, and at mid-day of the 8th arrived at the junction of the Madre de Dios with the Beni. No other white man has ever seen the mouth of this magnificent river. Crude measurements gave 735 feet for the width of the Beni, and 2350 for that of the Madre de Dios. Took careful observations for latitude and longitude. At 6:50 A. M. of the 9th, I passed the mouth of a river the size of the Yacuma, entering from the north, to which I gave the name Orton.

At night we slept on a sand-bar joined to a large island. On the 10th we passed this island, and at 8 A. M. another large one, and at 10 A. M. came to a line of rocks obstructing the river and making rapids. One mile further down we came to the main fall, which exhibits a perpendicular descent of the entire river of thirty feet. We occupied the remainder of the 10th in drawing our little craft over the rocks to the waters below. With much risk we passed the waves below the falls and camped. On the morning of October 11 we passed some rocks in the river corresponding to the rapids of the Palo Grande of the River Mamoré, but which, here, offer no serious obstructions to navigation. At 10 A. M., October 11, 1880, we arrived at the mouth of the Beni—that is, at the junction of the Beni and Mamoré rivers. From thence we ascended the Mamoré, 300 miles, to Exaltacion and Santa Ana, and from Santa Ana to this place, 200 miles west over the pampas; brought my boat on an ox cart.

Here I am safe and sound with a map of the three rivers—Beni, Mamoré and Yacuma. From the river Madidi to the mouth of the Beni there are but four families of Pacavara Indians in the place of "multitudes of man-eating savages," as every man, woman and child in Bolivia has believed during many scores of years. Rubber gatherers are already taking advantage of my exploration, and have established camps further down the Beni."

On account of superstitious fear of the unexplored portion of the river Beni, the productions of the rubber camps on the river Madidi have ascended the river Beni, 200 miles to Reyes, thence east 200 miles to river Mamoré, thence 300 miles north to its union with the Beni—700 miles around, in place of less than 300 miles direct. The waters of the Beni come down from the gold mines of Bolivia and through forests of Cinchona trees; and the Madre de Dios from a much larger area of similar territory of Peru.

Dr. Heath, alone, unaided, spent two years in patient, determined preparation near the scene of the proposed exploration, and then, in a frail canoe, with only two Indian servants, with certain death before them, as all Bolivia believed, paddled bravely forth to explore a great river and extensive country where, during 350 years, a score of costly expeditions have disastrously failed. It is thought that the governments of Peru and Bolivia will give official recognition of his daring and successful achievement. His work will develop and change the commerce of many hundred miles of mountain and plain. Rubber and bark will now descend the Beni, instead of going 600 or 700 miles around. What risk and danger he faced in descending an absolutely unknown river, larger than the Mississippi, in which were rapids and falls! What satisfaction he must have felt when his canoe entered the yellow waters of the Mamoré, having successfully braved the superstition of ages and opened up a new country to commerce!

Dr. Heath has achieved a noble work in exploring this unknown region, which will be recognized everywhere, and as long as the Orton river flows, men will remember the explorer whose name it bears, who contributed so much to our knowledge of South America, and gave up his life to the cause of science.

CONGRESSIONAL APPROPRIATIONS FOR SCIENTIFIC PURPOSES.

[The following extracts from the bill making appropriations for sundry civil expenses of the government for the fiscal year ending June 30th, 1882, will be of interest to our readers and to scientists generally:—EDITOR.]

THE HOWGATE POLAR EXPEDITION.—Observation and exploration in the Arctic Seas: For continuing the work of scientific observation and exploration on or near the shores of Lady Franklin Bay, and for transportation of men and supplies to said location and return, twenty-five thousand dollars.

Lieut. A. W. Greely, 5th U. S. Cavalry and Acting Signal Officer, has been assigned by the Secretary of War, to the command of this expedition. Lieut. Greely will be permitted to select such officers and men from the army as will be required to carry out the objects of the expedition. In our next issue we shall probably be able to give fuller details of the *personnel* of the expeditionary force.

THE BENNETT POLAR EXPEDITION.—To enable the Secretary of the Navy to immediately charter or purchase, equip, and supply a vessel for the prosecution of a search for the steamer Jeannette of the Arctic Exploring Expedition (which the Secretary of the Navy is hereby authorized to undertake), and such other vessels as may be found to need assistance during said cruise, one hundred and seventy-five thousand dollars: Provided, That said vessel shall be wholly manned by volunteers from the Navy.

On March 15th the Navy Department paid $100,000 for the whaling steamer Mary and Helen, to be sent in search of the Jeanette.

Geological Survey.—For the expenses of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain, to be expended under the direction of the Secretary of the Interior, including pay of civilian employees, one hundred and fifty thousand dollars.

The unexpected balance for the completion of the office work of the Geological and Geographical Survey of the Territories for the fiscal year, eighteen hundred and eighty-one, was also re-appropriated and made available for the same purposes.

Mississippi River Commission.—For salaries and traveling expenses of Commission, office expenses, and reduction of work; for continuation of surveys and gaugings of Mississippi River and its tributaries; for permanent gauge-stations and borings; for publication of maps and results, one hundred and fifty thousand dollars.

North American Ethnology.—For the purpose of continuing ethnological researches among the North American Indians, under the direction of the Secretary of the Smithsonian Institution, twenty-five thousand dollars; five thousand dollars of which shall be expended in continuing archæological investigations relating to Mound-builders and prehistoric mounds.

Smithsonian Institution.—For the expense of exchanging literary and scientific productions with all nations by the Smithsonian Institution, three thousand dollars.

Preservation of collections, Smithsonian Institution: For preservation and care of the collections of the surveying and exploring expeditions of the government, fifty-five thousand dollars.

Preservation of collections, Smithsonian Institution, Armory building: For expense of watching, care and storage of duplicate government collections, and of property of the United States Fish Commission, Two thousand five hundred dollars.

Under the Commissioner of Fish and Fisheries.—Propagation of food-fishes: For the introduction of shad and fresh-water herring into the waters of the Pacific, the Atlantic, the Gulf and Great Lake States, and of salmon, white-fish, carp, gourami, and other useful food-fishes into the waters of the United States generally, to which they are best adapted; also for the propagation of cod, herring, mackerel, halibut, Spanish mackerel, and other sea fishes, and for continuing the inquiry into the causes of the decrease of food-fishes of the United States, ninety-five thousand dollars, which shall be immediately available.

Coast and Geodetic Survey.—Survey of the Atlantic and Gulf coasts, eastern division: For every purpose and object necessary for, and incident to, the continuation of the survey of the Atlantic and Gulf coasts of the United States, the Mississippi and other rivers, to the head of either tidal influence or ship navigation; soundings, deep-sea temperatures, dredgings, and current-observations along the above-named coasts, in the Gulf of Mexico, and the Gulf Stream, including its entrance into the Gulf, its course through the Carribbean and into and around the Sargasso Sea; the triangulation toward the western coast, and furnishing points for State surveys; the preparation and publication of charts, the Coast Pilot, magnetic map of Eastern North America, and other results of the work, with the purchase of materials therefor, including compensation of civilians engaged in the work, three hundred thousand dollars.

For continuation of the resurvey of the Delaware Bay and river, ten thousand dollars.

Survey of the Pacific coasts, western division: For every purpose and object necessary for, and incident to, the continuation of the survey of the Pacific coasts of the United States, the Columbia and other rivers, to the head of either tidal influence or of ship-navigation; deep-sea soundings, temperatures, currents, and dredgings along and also in the Japan Stream, flowing off these coasts; the triangulation toward the eastern coast, and furnishing points for State surveys; the preparation and publication of charts, the Coast Pilot, the magnetic map of Western North America, and other results of the work, with the purchase of materials therefor, including compensation of civilians employed in the work, one hundred and eighty thousand dollars.

Signal Service.—Observation and report of storms: For the expenses of the observation and report of storms by telegraph and signal for the benefit of commerce and agriculture throughout the United States; for manufacture, purchase, and repair of meteorological and other necessary instruments; for telegraphing reports; for expenses of storm-signals announcing the probable approach and force of storms; for continuing the establishment and connection of stations at life-saving stations and light-houses; for instrument-shelters; for hire, furniture, and expenses of offices maintained for public use in cities and ports receiving reports; for river reports; for maps and bulletins to be displayed in chambers of commerce and boards of trade rooms, and for distribution; for *original studies*, books, periodicals, newspapers, and stationery; and for incidental expenses not otherwise provided for, three hundred and seventy-five thousand dollars.

SIBERIAN COMMERCE.

A document has been issued by the German Foreign Office describing the various attempts made during the past three years to reach the mouths of the Siberian river by way of the North Cape. In 1878, seven vessels undertook the voyage to the Artic Sea; two steamers arrived in Orbi, four in the Yenisei, and the seventh, a sailing vessel in the Lena, up which river it sailed to Jakustok, a distance of 2700 versts. The greater number of these vessels returned to Europe in the same season with return freights.

The attempts made in the two following years were less successful. Of seven ships which left in 1879 only one was able to accomplish the voyage around the North Cape. In 1880 five ships penetrated into the sea of Kara. The two German steamers, the *Lutse* and the *Dahlmann*, bound for the Yenisei river, forced to return. The *Dahlmann* encountered to the northward of Novayo Zemlya, a sea of ice as impenetrable as that which it had met with in the south side of the island. The ship *Nordland*, freighted by the well known Russian Merchant Siberiakoff, twice entered the Sea of Kara but its progress was also stopped by heavy masses of ice and had to return to Europe. This failure did not discourage the enterprising merchant, for in July, 1880, he himself started for the North in the steamer *Oscar Dickson*, charted in Gothenburg and provisioned for ten months. He left Vardõ in August, arrived in Jugor Strait before the end of the month, but the whole month of September was spent in vain attempts to cross the Kara Sea. Later in the year the ship was seen by the captain of the steamer *Neptune* in the Matotskin Schar, sailing up and down to the ea tward of Novayo Zemlya, and once returning through that strait to the western side of the island. For some time no farther news was received of the whereabouts of the *Dickson*, excepting a rumor that she was frozen in at the mouth of the Yenesei. In consequence of this rumor Siberakoff's brother sent an overland expedition to the mouth of that river. Subsequently news was received of the *Dickson's* safe arrival at Tobolsk.

Only the fifth ship, the *Neptune*, already mentioned, reached the mouth of the Orbi and returned in the same season to Europe laden with grain. The condition of navigation in the Kara Sea as shown by the experience of the last three years, have disappointed the hopes of a productive and profitable commerce hitherto entertained, but it is possible that further experience and observations will remove many of the obstacles that were encountered.

For this purpose observing stations are about to be established at the mouth of the Lena and Kolyma, or upon one of the New Siberian Islands. Lieut. Türgens has been assigned to the direction of the station on the Lena.

METEOROLOGICAL STATIONS IN BEHRINGS SEA.

The Signal Service, in coöperation with the Smithsonian Institution, the N. W. Trading Co., the Western Fur and Trading Co., and the Alaska Commercial Co., proposes to establish an extensive system of stations during the present year, for the purpose of making an exhaustive study of the meteorological and other natural phenomena of the exterme northwest coast of the American continent, and of the islands in Behrings Sea.

The stations named below have been partially decided upon for occupation. The Latitude and Longitude given are approximative only:

STATIONS.	LATITUDE.	LONGITUDE.
Copper Island	54° 30′	192° 00′
Attu Island	53° 00′	187° 00′
Atka Island	52° 30′	174° 30′
Unalaslika Island	53° 00′	166° 00′
St. Paul Island	57° 30′	170° 00′
St. Michaels	63° 30′	162° 00′
Point Barrow	71° 30′	156° 30′
Nuchagakak.	61° 00′	162° 00′
Sitka	57° 00′	135° 30′
Cordova Bay	54° 45′	132° 20′
Portage Bay	59° 00′	135° 30′
Yakutat	59° 30′	140° 00′
Fort Yukon	66° 30′	145° 00′
Fort Renai	61° 00′	151° 00′
Port Etches	60° 30′	147° 00′
Kuskokvim	61° 00′	161° 30′

And eleven other stations not yet selected. It is expected that Russia will establish a coöperating station at Petropadlovsk in about Latitude 53° and Longitude 201°.

The station at Point Barrow is part of the American quota of the International chain of Polar Stations.

The Meteorological Office of Canada, under the energetic supervision of Mr. Carpuxael, proposes to establish a full station on Melville Island, at Winter Harber, in Lat. 74° 45′; Long. 111°, provided the necessary Government assistance can be obtained. The proposed site is where Parry wintered in 1819–20, and is an admirable location for one of the International chain of stations.

ASTRONOMY.

PLANETARY PHENOMENA FOR APRIL, 1881.

BY W. W. ALEXANDER, KANSAS CITY, MO.

Mercury on the 7th reaches its greatest elongation west, but owing to its position being so much south of the sun, it cannot be observed well from Kansas City.

Venus on the 11th reaches the stationary point in its orbit, *i. e.*, its position among the fixed stars will remain unchanged for a short time. This apparent rest in its motion is caused by our being in the direction in which it is moving; after this it will continue rapidly to approach the sun, being so near to that orb after the 25th as to escape observation except with the telescope.

Mars during this month will be among the stars in Aquarius.

Jupiter and Saturn have approached so near the sun's place that a good view of them cannot be obtained this month. On the 22d they are in conjunction with each other and also with the sun.

Uranus is situated in the constellation Leo about 12° east and 4° south of Regulus, the brightest star of that constellation. It is now in a very favorable position for observation, and as only a few persons have ever seen this planet the present opportunity should not be missed. It shines with the light of a 6th magnitude star, and under the most favorable circumstances is visible to the naked eye.

Neptune is situated in the constellation Aries, but being so faint, owing to its enormous distance, cannot be seen except with good astronomical instruments.

The Moon on the 1st is in conjunction with Venus, passing south of that planet 3° 22′. On the 10th it is within 6° 19′ of Uranus. By the 28th it will be again in conjunction with Venus, passing south 2° 40′, but both will be so near the sun that they cannot be seen with the unaided eye.

DELICATE SCIENTIFIC INSTRUMENTS, AND SOME RECENT RESULTS OF THEIR USE.

BY EDGAR L. LARKIN, NEW WINDSOR OBSERVATORY, NEW WINDSOR, ILLINOIS.

Within the last five years, scientific men have surpassed previous efforts in close measurement and refined analysis. By means of instruments of exceeding delicacy, processes in nature hitherto unknown, are made palpable to sense. Heat is found in ice, light in seeming darkness, and sound in apparent silence. It seems that physicists and chemists have almost if not quite reached the ultimate atoms of matter. The mechanism must be sensitive, as such properties of matter as heat, light, electricity, magnetism and actinism, are to be handled, caused to vanish and reappear, analyzed and measured. With such instruments, nature is scrutinized, revealing new properties, strange motions, vibrations and undulations. Throughout the visible universe, the faintest pulsations of atoms are detected, and countless millions of infinitely small waves, bearing light, heat and sound are discovered and their lengths determined. Refined spectroscopic analysis of light is now made, so that when any material burns, no matter what its distance, its spectrum tells what substance is burning. When any luminous body appears, it can be told whether it is approaching or receding, or whether it shines by its own or reflected light; whence it is seen that rays falling on earth from a flight of a hundred years, are as sounding lines dropped in the appalling depths of space. We wish to describe a few of these intricate instruments, and mention several far-reaching discoveries made by their use; beginning with mechanism for the manipulation of light. Optics is based on the accidental discovery that a piece of glass of certain shape will draw light to a focus, forming an image of any object at that point. The next step was in learning that this image can be viewed with a microscope, and magnified; thus came the telescope revealing unheard of suns and galaxies. The first telescopes colored everything looked at, but by a hundred years of mathematical research, the proper curvature of objectives formed of two glasses was discovered, so that now we have perfect instruments. Great results followed; one can now peer into the profound solitudes of space, bringing to view millions of stars, requiring light 5,000 years to traverse their awful distance, and behold suns wheeling around suns, and thousands of nebulæ, or agglomerations of stars so distant as to send us confused light, appearing like faint gauze-like structures in measureless voids. The modern telescope has astonishing power, thus: When Mr. Clark finished the great 26-inch Equatorial, now at Washington, he tested its seeing properties. A photographic calligraph whose letters were so fine as to require a microscope to see them, was placed at a distance of three hundred feet. Mr. Clark turned the great eye upon the invisible thing and read the writing with ease. But a greater feat than this was accomplished by the same instrument—the discovery of the two little moons of Mars, by Prof. Asaph Hall, in 1877. They are so small as to be incapable of measurement by ordinary means, but with an ingenious photometer devised by Prof. Pickering of Harvard College, he determined the outer satellite to be six, and the inner seven miles in diameter. The discovery of these minute bodies seems past belief, and will appear more so, when it is told that the task is equal to that of viewing a luminous ball two inches in diameter suspended above Boston, by the telescope situated in the city of New York. [Newcomb and Holden's Astronomy, p. 338.

Phobos, the nearest moon, is only 4,000 miles from the surface of Mars, and is obliged to move with such great velocity to prevent falling, that it actually makes a circuit about its primary in only 7 hours 38 minutes. But Mars turns on *its* axis in 24 hours 37 minutes, so the moon goes round three times, while Mars does once, hence it rises in the west and sets in the east, making one day of Mars equal three of its months. This moon changes every two hours, passing all phases in a single Martial night; is anomalous in the solar system, and tends to subvert that theory of cosmic evolution wherein a rotating gaseous sun cast off concentric rings, afterward becoming planets. Astronomers were not satisfied with the telescope; true, they beheld the phenomena of the solar system; planets rotating on axes, and satellites revolving about them. They saw sunspots, faculæ and solar upheaval; watched eclipses, transits, and the alternations of summer and winter on Mars, and detected the laws of gravity and motion in the system to which the earth belongs. They then devised the Micrometer. This is a complex mechanism placed in the focus of a telescope, and by its use any object, providing it shows a disc, no matter what its distance, can be measured. It consists of spider webs set within a graduated metallic circle, the webs movable by screws, and the whole instrument capable of rotating about the collimation axis of the telescope. The screw head is a circle ruled to degrees and minutes, and turns in front of a fixed vernier in the field of a reading microscope. One turn of the screw moves the web a certain number of seconds; then as there are

360° in a circle, 1-360th of a turn moves the web 1-360th of the amount, and so on. Thus, when two stars are seen in the field, one web is moved by the screw until the fixed line and the movable one are parallel, each bisecting a star. By reading with the microscope, the number of degrees turned the distance apart of the stars becomes known; the distance being learned, position is then sought; the observance of which led to one of the greatest discoveries ever made by man. The permanent line of the micrometer is placed in the line joining the north and south poles of the heavens, and brought across one of the stars; the movable web is then rotated until it bisects the other, and then the angle between the webs is recorded. Double stars are thus measured, first in distance, and second, their position. After this, if any movement of the stars takes place, the tell tale micrometer at once detects it.

In 1780, Sir Wm. Herschel measured double stars and made catalogues with distances and positions. Within twenty years, he startled intellectual man with the statement that many of the fixed stars actually move—one great sun revolving around another, and both rotating about their common center of gravity. If we look at a double star with a small telescope, it looks just like any other; using a little larger glass, it changes appearance and looks elongated; with a still better telescope, they become distinctly separated and appear as two beautiful stars whose elements are measured and carefully recorded, in order to see if they move. Herschel detected the motion of fifty of these systems, and revolutionized modern astronomy. Astronomers soared away from the little solar system, and began a minute search throughout the whole sidereal heavens. Herschel's catalogue contained 400 double suns, only fifty of which were known to be in revolution. Since then, enormous advance has been made. The micrometer has been improved into an instrument of great delicacy, and the number of doubles has swelled to 10,000; 650 of them being known to be binary, or revolving on orbits—Prof. S. W. Burnham, the distinguished young astronomer of the Dearborn Observatory, Chicago, having discovered 800 within the last eight years. This discovery implies stupendous motion; every fixed star is a sun like our own, and we can imagine these wheeling orbs to be surrounded by cool planets, the abode of life, as well as ours. If the orbit of a binary system lies edgewise toward us, then one star will hide the other each revolution, moving across it and appearing on the other side. Several instances of this motion are known; the distant suns having made more than a complete circuit since discovery; the shortest periodic time known being twenty-five years.

Wonderful as was this achievement of the micrometer, one not less surprising awaited its delicate measurement. If one walks in a long street lighted with gas, the lights ahead will appear to separate, and those in the rear approach. The little spider lines have detected just such a movement in the heavens. The stars in Hercules are all the time growing wider apart, while those in Argus, in exactly the opposite part of the Universe, are steadily drawing nearer together. This demonstrates that our sun with his stately retinue of planets, satellites, comets and meteorites, all move in grand march toward the constellation, Hercules. The entire Universe is in motion. But these revelations of the micrometer are tame compared with its final achievement, the discovery of parallax.

This means difference of direction, and the parallax of a star, is the difference of its direction when viewed at intervals of six months. Astronomers observe a star to-day with a powerful telescope and micrometer; and in six months again measure the same star. But meanwhile the earth has moved 183,000,000 miles to the east, so that if the star has changed place, this enormous journey caused it, and the change equals a line 91,400,000 miles long as viewed from the star. For years many such observations were made; but behold the star was always in the same place; the whole distance of the sun having dwindled down to the diameter of a pin point in comparison with the awful chasm separating us from the stars. Finally micrometers were made that measured lines requiring 100,000 to make an inch; and a new series of observations begun, crowning the labors of a century with success. Finite man actually told the distance of the starry hosts and gauged the universe.

When the parallax of any object is found, its distance is at once known, for the parallax is an arc of a circle whose radius is the distance. By an important theorem in geometry it is learned, that when anything subtends an angle of 1″ its distance is 206,265 times its own diameter. The greatest parallax of any star is that of Alpha Centauri—$\frac{9}{10}$ of a second; hence it is more than 206,265 times 91,400,000 miles—the distance of the sun—away, or twenty thousand billions of miles. This is the distance of the nearest fixed star, and is used as a standard of reference in describing greater depths of space. This is not all the micrometer enables man to know. When the distance separating the earth from two celestial bodies that revolve is learned, the distance between the two orbs becomes known. Then the period of revolution is learned from observation, and having the distance and time, then their velocity can be determined. The distance and velocity being given, then the combined weights of both suns can be calculated, since by the laws of gravity and motion it is known how much weight is required to produce so much motion in so much time, at so much distance, and thus man weighs the stars. If the density of these bodies could be ascertained, their diameters and volumes would be known, and the size of the fixed stars would have been measured. Density can never be exactly learned; but strange to say, photometers measure the quantity of light that any bright body emits; hence the stars cannot have specific gravity very far different from that of the sun, since they send similar light, and in quantity obeying the law wherein light varies inversely as the squares of distance. Therefore, knowing the weight and having close approximation to density, the sizes of the stars are nearly calculated. The conclusion is now made that all suns within the visible universe, are neither very many times larger nor smaller than our own. (Newcomb and Holden's Astronomy, p. 454).

Another result followed the use of the micrometer; the detection of the proper motion of the stars. For several thousand years the stars have been called "fixed," but the fine rulings of the filar micrometer tell a different story. There are catalogues of several hundred moving stars, whose motion is from ½″ to 8″ annually. The Binary star, 61 Cygni, the nearest north of the equator moves 8″ every year, a displacement equal in 360 years to the apparent diameter of the moon. The fixed stars have no general motion toward any point, but move in all directions.

Thus the micrometer revealed to man the magnitude and general structure, together with the motions and revolutions of the sidereal heavens. Above all, it demonstrated that gravity extends throughout the universe. Still the longings of men were not appeased; they brought to view invisible suns sunk in space, and told their weight, yet the thirst for knowledge was not quenched. Men wished to know what all the suns are made of, whether of substances like those composing the earth, or of kinds of matter entirely different. Then was devised the spectroscope, and with it men audaciously questioned nature in her most secluded recesses. The basis of spectroscopy is the prism, which separates sun-light into seven colors and projects a band of light called a spectrum. This was known for 300 years, and not much thought of it until Fraunhöfer viewed it with a telescope, and was surprised to find it filled with hundreds of black lines invisible to the unaided eye. Could it be possible that there are portions of the solar surface that fail to send out light? Such is the fact, and then began a twenty years search to learn the cause. The lines in the solar spectrum were unexplained until finally metals were vaporized in the intense heat of the electric arc and the light passed through a spectroscope, when behold the spectra of metals were filled with bright lines in the same places as were the dark lines in the spectrum of the sun. Another step; if when metals are volatilized in the arc, rays of light from the sun are passed through the vapor and allowed to enter the spectroscope, a great change is wrought; a reversal takes place, and the original black bands reappear. A new law of nature was discovered, thus: "Vapors of all elements absorb the same rays of light which they emit when incandescent." Every element makes a different spectrum with lines in different places and of different widths. These have been memorized by chemists, so that when an expert having a spectroscope sees anything burn he can tell what it is as well as read a printed page. Men have learned the alphabet of the Universe, and can read, in all things radiating light, the constituent elements. The black lines in the solar spectrum are there because in the atmosphere of the sun exist vapors of metals, and the light from the liquid metals below is unable to pass through and reach the earth, being absorbed kind for kind. Gaseous iron sifts out all rays emitted from melted iron, and so do the vapors of all other elements in the sun, radiating light in unison with their own. Sodium, iron, calcium, hydrogen, magnesium and many other substances are now known to be incandescent in the sun and stars; and the results of the developments of the spectroscope may be summed up in the generalization that all bodies in the Universe are composed of the same substance the earth is.

The sun is subject to terrific hurricanes and cyclones, as well as explosions, casting up jets to the height of 200,000 miles. In the early days of spectroscopy these protuberances could only be seen at a time of a total solar eclipse, and astronomers made long journeys to distant parts of the earth to be in line of totality. Now all is changed. Images of the sun are thrown into the observatory by an ingenious instrument run by clock work, and called a Heliostat. This is set on the sun at such an angle as to throw the solar image into the objective of the telescope placed horizontally in a darkened observatory, and the pendulum balset in motion, when it will follow the sun without moving its image, all day if desired. At the eye end of the telescope is attached the spectroscope and the micrometer, and the whole set of instruments so adjusted that just the edge of the sun is seen, making a half spectrum. The other half of the spectroscope projects above the solar limb, and is dark, so if an explosion throws up liquid jets, or flames of hydrogen, the astronomer at once sees them and with the micrometer measures their height before they have time to fall. And the spectrum at once tells what the jets are composed of, whether hydrogen, gaseous iron, calcium or anything else. Prof. C. A. Young saw a jet of hydrogen ascend a distance of 200,000 miles, measured its height, noted its spectrum and timed its ascent by a chronometer all at once, and was astonished to find the velocity 160 miles per second; eight times faster than the earth flies on its orbit. By these improvements solar hurricanes, whirlpools and explosions can be seen from any physical observatory on clear days.

The slit of the spectroscope can be moved anywhere on the disc of the sun; so that if the observer sees a tornado begin, he moves the slit along with it, measures the length of its track and velocity. With the telescope, micrometer, heliostat and spectroscope came desire for more complex instruments, resulting in the invention of the Photoheliograph, invoking the aid of photography to make permanent the results of these exciting researches. This mechanism consists of an excessively sensitive plate, adjusted in the solar focus of the telespectroscope. In front of the plate in the camera is a screen attached to a spring, and held closed by a cord. The eye is applied to the spectroscopic end of the complex arrangement to watch the development of solar hurricanes.

Finally an appalling out-burst occurs; the flames leap higher and higher, torn into a thousand shreds, presenting a scene that language is powerless to describe. When the display is at the height of its magnificence, the astronomer cuts the cord; the slide makes an exposure of 1-3000 part of a second, and an accurate photograph is taken. The storm all in rapid motion is petrified on the plate; everything is distinct, all the surging billows of fire, boilings and turbulence are rendered motionless with the velocity of lightning.

At Meudon, in France, M. Janssen takes these instantaneous photographs of the sun, thirty inches in diameter, and afterward enlarges them to ten feet; showing scenes of fiery desolation that appalls the human imagination. (See address of Vice-President Langley, A. A. A.S., Proceedings Saratoga Meeting, p 56.)

This huge photograph can be viewed in detail with a small telescope and micrometer, and the crests of solar waves measured. Many of these billows of fire are in dimensions every way equal in size to the state of Illinois. Binary stars are photographed so that in time to come they can be re-taken, when if they have moved, the precise amount can be measured.

Another instrument is the Telepolariscope, to be attached to a telescope. It tells whether any luminous body sends us its own, or reflected light. Only one comet bright enough to be examined has appeared since its perfection. This was Coggía's, and was found to reflect solar from the tail, and to radiate its own light from the nucleus.

Still another intricate instrument is in use, the Thermograph, that utilizes the heat rays from the sun, instead of the light. It takes pictures by heat; in other words it sees in the dark; brings invisible things to the eye of man, and is used in astronomical and physical researches wherein undulations and radiations are concerned. And now comes the Magnetometer, to measure the amount of magnetism that reaches the earth from the sun. It points to zero when the magnetic forces of the earth are in equilibrium, but let a magnetic storm occur anywhere in the world and the pointer will move by invisible power. It detects a close relation between the magnetism of the earth and sun. The needle is deflected every time a solar disturbance takes place. At Kew, England, an astronomer was viewing the sun with a telescope and observed a tongue of flame dart across a spot, whose diameter was 33,700 miles. The magnetometer was violently agitated at once, showing that whatever magnetism may be, its influence traversed the distance of the sun with a velocity greater than that of light.

Not less remarkable is the new instrument the Thermal Balance devised by Prof. S. P. Langley Píttsburg. It will measure the 1-50.000 part of a degree of heat, and consists of strips of platinum 1-32 of an inch wide and ¼ of an inch long; and so thin that it requires fifty to equal the thickness of tissue paper, placed in the circuit of electricity running to a galvanometer. "When mounted in a reflecting telescope it will record the heat from the body of a man or other animal in an adjoining field, and can do so at great distances. It will do this equally well at night, and may be said, in a certain sense, to give the power of seeing in the dark. ("Science," issue of Jan. 8, 1881, p 12.) It is expected to reveal great facts concerning the heat of the stars.

Indeed, the Thermopile in the hands of Lockyer has already made palpable the heat of the fixed stars. He placed the little detective in the focus of a telescope and turned it on Arcturus. "The result was this, that the heat received from Arcturus, when at an altitude of 55°, was found to be just equal to that received from a cube of boiling water, three inches across each side, at the distance of 400 yards; and the heat from Vega is equal to that from the same cube at 600 yards." (Lockyer's Star Gazing, p 385.) Thus that inscrutable mode of force heat, traverses the depths of space, reaches the earth, and turns the delicate balance of the thermopile. Another discovery was made with the spectroscope; thus, if a boat moves up a river, it will meet more waves than will strike it if going down stream. Light is the undulation of waves; thence if the spectroscope is set on a star that is approaching the earth, more waves will enter, than if set on a receding star, which fact is known by displacement of lines in the spectroscope from normal positions. It is found that many fixed stars are approaching, while others are moving away from the solar system.

We cannot note the researches of Edison, Lockyer or Tyndall, nor of Crookes, who has seemingly reached the molecules whence the Universe is composed.

The modern observatory is a labyrinth of sensitive instruments; and when any disturbance takes place in nature, in heat, light, magnetism, or like modes of force, the apparatus notes and records them.

Men are by no means satisfied. Insatiable thirst to know more is developing into a fever of unrest; they are wandering beyond the limits of the known, every day a little farther. They survey space, and interrogate the Infinite; measure the atom of hydrogen and weigh suns. Man takes no rest, and neither will he until he shall have found his own place in the chain of nature.

March 29th, 1881.

METEOROLOGY.

THE STORM CENTER AND WEATHER PROPHETS.

BY ISAAC P. NOYES, WASHINGTON, D. C.

The weather since the first of January 1881 has not even been as complimentary to Mr. Vennor as was that of December 1880, and re-affirms the statements so often made in these papers, in regard to the absurdity of attempting to guess at the weather, months, or even weeks in advance. Had we had the usual mid-January thaw, ignorant people and even many well informed people, would have claimed that it was all in accordance with Mr. Vennor's predictions and evidence of his great skill and knowledge in prophesying the weather.

Nine times out of ten it would be safe to venture a prediction, "that about the middle of January we would have a thaw," or at least some time in January. But this year for very simple reasons we did not have the thaw.

As stated in former papers, in winter, when the sun is south of the equator, the area of low-barometer travels on a lower line than during the summer months; and as the wind is always toward "low," it necessarily follows that the wind will be more generally from the north and hence cold. When the sun advances north the general effect is to advance the area of low-barometer to a higher line of latitude. Notwithstanding this general effect of the sun in developing *low*, and *low* being generally on a higher line in summer than in winter, there are times in summer when it is on a very low line, and times in winter when it is on a very high line. It seldom, if ever goes over exactly the same ground, though it often takes a similar course · and after running on one general line for a few times in succession, there will be a change to some opposite or extreme line, higher or lower, as the case may be.

So when fall sets in, the area of low-barometer creeps down relatively with the sun, and then as the sun advances north, this area of *low* goes north with it, yet all the while, with the changes herein spoken of intervening, making in summer north winds, and relatively cold days, and in winter southerly winds and relatively warm days. When one becomes familiar with these motions of *low*, or the concentration of the sun's heat, studies the causes, which day by day, week by week and month by month it follows—its regularity and irregularity—how steady at times it follows just where it would seem it ought to go, and how capricious at other times, as though it was determined to surprise man by both its regularity and irregularity; when we become cognizant of the laws which this department of nature follows; how it would seem bent on defying us to say when and where it will go, and when and where it will not go; when our senses perceive this, then and not until then will we realize the absurdity of the attempt to revive the old method of guessing at the weather for months in advance, or putting confidence in any person's attempt to indicate what the weather will be, from any pretended calculation of the movements of the moon or stars.

We all know that it is cold in winter and warm in summer, and that in the spring we will have blustering weather, cold winds and rain, and as the spring approaches summer, have what are known as "April showers"—sunshine and rain suddenly and closely interspersed. A little later, hot sultry days—long and protracted dry spells, with sudden changes and violent storms, accompanied with thunder and lightning. As the season advances, more evenly distributed areas of rain—days when it is quite cold and it would seem that winter had come, but it has not, for following this are those delightful hazy days in autumn, October and November, which are known in this country as "Indian Summer," for the reason that the first settlers thought on the first approach of cold weather, that winter had come, but the Indians told them that there would follow quite a spell of mild pleasant weather before the cold of winter really set in, and so it did and hence the name "Indian Summer." In those days the cause of this could not be explained, but to-day it can, and in former papers has been explained. Following this "Indian Summer" is the cold of winter, earlier in northern than in southern latitudes, (north of the equator) All this general knowledge of the weather of the months we know and knew before a weather bureau was established, or thought of, but we did not know the causes of the changes and their peculiarities.

There is no wisdom in any one telling us that it will be cold in winter or warm in summer, or generally that "July will be hot, with thunder storms," or "December cold, with heavy falls of snow," for these are the things or conditions which naturally follow, and if they do not follow, form an exception in the weather of the year. We are continually having these exceptions—in the days—in the weeks—in the months and in the years. These *exceptions* are a part of the regular things to be expected, but there is no regularity about them, however. If there were, the exceptional features would lose their character.

This area of *low* is a very coy thing on the part of nature. Now like a wise, benevolent and broad-minded philanthropist it dispenses its bounties evenly, visiting on its course one section and another, giving all alike, at least all sufficient; then a change and as it were, Peter is robbed to pay Paul, or even worse, Peter robbed and denied the essentials of life to drown Paul with; an overflowing abundance that is detrimental rather than beneficial to him. Let people simply study the weather map and this will all be revealed to them, and more, they will soon see the absurdity of any person attempting to make such prophecies in regard to the weather, and of the attempt to write or speak on the subject without this knowledge.

A sea-captain would be more reasonable in this day, to attempt to navigate the seas and oceans of the globe without compass, quadrant and charts. We can not know much about navigation by merely knowing a few general laws of physics. We must, in order to know navigation, have knowledge of the tides, the compass, know how to take the sun and how to work our way by the charts, light-houses, buoys, etc. So when it comes to a knowledge of the weather, we must know a little more than the general laws of physics; we must make ourselves familiar with the movements of the sun in the ecliptic, with the parallelism of the earth, with the topography of the land, the distribution of land and water, of plains and mountains, and foliage, and even with the advancement of civilization. For, where civilization goes railroads are sure to follow, and it seems now to be well known and admitted, that railroads under certain relations to territory have more or less effect.

On the Western plains, where little or no rain occurred before the advent of the railroad, rain is now said to be quite frequent. The cause of this would seem to be that the iron rails attract the rays of the sun, and develop and retain heat, thereby making an area of low barometer practical in such localities, where before the dryness of the country repelled it or so neutralized it as to make it non-effective. This re-acts and produces trees, and so soon as foliage is developed, all the essential features for developing and retaining a *low* or making it a practical reality is secured. For *low* will not remain over night and thereby be sufficiently permanent to secure moisture to the land unless there is something to retain the heat developed by the sun.

Where there is moisture there is more material to form clouds, and where this moisture is the more clouds will hover over the spot and the factor *heat* be retained, by which other clouds are brought there to precipitate. This reveals to us the mystery of the superiority of territory where land and water are well distributed, and the necessity of restoring the balance where it is practicable. Land and water are both essential to our well being; organized as we are, we could not live here without the two in at least fair proportions to retain such a balance of heat and cold, dryness and moisture, as is essential to human life. So the forces of nature, like the artificial forces, developed by civilized man, act and re-act upon each other. Let a few persons establish themselves in a certain spot, others follow in order to meet the demands of trade, supplies, and even luxuries. Their demands as individuals and as a settlement increases as the settlement grows. Nature works on a similar plan. Take an arid country—too dry and suddenly tempestuous for habitation; civilization advances to it. The railroad passing through it develops a capacity to retain heat; some humanitarian, like the man who planted the acres of pines along the desert wastes of Cape Cod, in Massachusetts, some man with an eye to the future, starts a few trees, and perhaps, at great expense, an Artesian well, or conducts water from some distant and more favored locality; it may be for his own selfish gain, yet he cannot enjoy his gain alone; indeed his gain becomes greater as others enjoy it with him; he and his neighbors act and re-act upon each other. This little water, this railroad, these few trees, are the nucleus. Other similar things follow and act and re-act upon each other, and teach the lesson and wisdom of the benefits to man, individually and collectively, by generosity, combination and the bringing together of natural forces, and how one set of natural forces may, to the great advantage of man, be made to neutralize another set, and that with advanced civilization come even blessings that we little dreamed of, and reveal to us what a generous thing nature is if we will only court her in a becoming manner. She is ever more ready to give than we to receive, if we will only have the wisdom to deal with her as we should. Nothing more than this teaches man, or more strongly reveals to him the importance of studying nature, and making himself familiar with the works of nature, and acting generously toward his fellow man. For we are so constituted that the more we elevate what is about us the more we elevate and benefit ourselves.

It would seem that mere selfishness would prompt men to such acts, but the trouble with mere selfishness is that it is very short sighted, and works for the immediate present rather than the eternal future. He who acts for the immediate present is necessarily interested in ignorance, for his whole trust is in this element whether he be honest or deceptively pretentious.

A person who pretends or is simple enough to think that he can figure out the weather, months in advance, is either ignorant himself of the laws which govern the weather, or presumes that his fellows are, and perhaps both, and in either case his dependence is in the ignorance of his fellow men rather than in their enlightenment.

After January had passed and we had entered February, Mr. Vennor comes out with a card and admits that the January thaw did not take place. He had made some miscalculation or other, and the *thaw had been crowded out by the extreme cold.* (*!*).

If Mr. Vennor had known what caused the continued cold weather of December and January, would it not seem natural that he should have informed the public, but he seems to be as innocent and ignorant of it as an unborn babe, for he tells us that the thaw was *crowded out* (!). Yet it is said that this man is a scientist, at the head of the Canadian Meteorological Bureau, and a scientific man. I would like to see some medical man give some medical reason for the non-occurrence of something in his line on a par with this; some statesman; some lawyer—scientist or artist, attempt to hood-wink the public with *such a reason* (!).

If he were a person worth noticing the press of the land would soon make him the laughing stock of the age. The simple reason why we so often have a thaw in mid-winter is because of a high area of low barometer—that is, a number, say three or four or more areas of low barometer running on a high line of latitude with no similar area in the South to neutralize it. This causes south winds and gives us rain and thaw at the North, the result of which is to break up the ice and to sufficiently melt the snows to flood the streams, carrying off the ice and snow at least in part. We did not have this, at least, to any extent this year, for the reason that *low* was generally on a low line of latitude producing extreme cold with heavy rains, and even snow in the extreme Southern states.

They had more snow in New Orleans, in consequence, this year, than perhaps ever before. Snow in New Orleans is a very uncommon thing and had some person told the world, or even made a venture that such a thing would have occurred, by those ignorant of science he would have been termed a weather prophet indeed. It was an exceptional thing and the weather-map reveals the cause thereof, as well as a chart of the ocean which shows a dangerous reef would reveal the cause of the destruction of a vessel that was wrecked thereon. Now there is one thing these "weather prophets" may do, whereby they may obtain notoriety with the uninitiated, and that is to take the weather-map, study it for awhile in order to make themselves familiar with the workings of "High" and "Low" and then venture a daily guess of three or four days ahead of the Signal Office, and if they are expert, they may come pretty near the mark.

Indeed it would seem that it was full time that the Signal Office took a new departure and advanced a step. It is sure to come some day, and as they have the best facilities, it would seem that they were the ones to do it, and that is, in addition to their present daily "Indications," have a sub-indication, which will be understood not to be so reliable, and one in which they may be allowed more latitude. Let the basis on which they would make these new advanced indications be understood, then intelligent people will not hold them responsible, but will with them take the chances.

The better the public understand the weather-map the better will this be revealed to them, and the better they will understand the duties and difficulties of the Signal Office if they should undertake this new departure. If they assume this extra task they might adopt some new term, which will not be so positive as the term at present used for the daily information given to the public. But whatever the term may be, let it be distinctly understood that the greater the time in advance, the more uncertainty; still, oftentimes the weather for three or four days in advance, may be quite correctly given or revealed. If the Signal Office does not do this in course of time, some enterprising outsider will be sure to, and he will use their knowledge and material to accomplish it.

It would seem that it was full time that they added this auxiliary feature to their present daily indications. The intelligent world at least will be charitable toward them, and will not hold them too closely to the mark, and if they have the intelligent and generous people on their side, those who are able to understand the whys and wherefores, they need not fear the ignorant and exacting. The more the weather subject is understood, the more charity will the intelligent people of the country have for this office, and the more will they appreciate its labors, and the less respect will this same intelligent class have for all those would-be weather-prophets, who are assuming so much ignorance on the part of the public at large, and pretending to know so much more than other people, and more than the facts in the case will warrant. It is full time that the intelligent people of the world took hold of this subject and mastered it. They will find enough in it to fully repay them for the pains, and it will protect them against the imposition that at present they are so susceptible to and unprotected against.

KANSAS WEATHER SERVICE OBSERVATIONS AT WASHBURN COLLEGE, TOPEKA.

BY PROF. J. T. LOVEWELL.

Our last report closed February 20th, and the eight days succeeding gave us milder weather with no precipitation or storms, and the lowest temperature was 8°. During the first two decades in March the weather has further moderated. The heaviest fall of snow of this period was on the 7th, when about four inches of damp snow fell. It also snowed on the 2d and 17th; and rained on the 10th and 15th. The most noticeable phenomenon was the extremely low barometer on the 11th, when the reading was 28.12 at 9 p. m.; this is nearly .3 of an inch lower than observed at this station for more than two years, No storm occurred here during or immediately after this. There was thunder and lightning on the 14th and 15th. The first prairie fire occurred on the 13th. The highest temperature was 59°, on the 15th. The pressure has been below the average during the past month. The weather has been rather cold for the season, but we must regard it on the whole as favorable to vegetation, and there has been no premature starting of the buds. The following averages by decades will give a more com. plete statement of these facts. Robins were first seen here this year on Feb. 22.

	Feb. 21st to 28th.	Mar. 1st to 10th.	Mar. 11th to 20th	Mean.
TEMPERATURE.				
Min.	17 4	20.6	24.9	21.0
Max.	41.5	41 4	47 3	43.4
Mean of Max and Min.	29.4	31 0	36.1	32.2
Range.	24 1	20 8	22.4	25 8
7 a. m.	20 6	23.6	29 3	24.5
2 p. m.	34.1	37 6	40.5	37.4
9 p. m.	27.5	29.9	33.0	30 1
Mean	27.9	30.2	34.0	30.7
REL. HUMIDITY.				
7 a. m.	.89	. .	.78	.83
2 p. m.	.74	. .	.76	.75
9 p. m.	.81	. .	.83	.82
Mean	.80	. .	.78	.79
PRESSURE, sea-level, 32° F.				
7 a. m.	28.95	28.85	28 77	28 86
2 p. m	28.91	28.81	28 74	28.85
9 p. m.	28 94	28 83	28 77	28 85
Mean	28.93	28.83	28.76	28.84
WIND.				
Miles Traveled	3,050	4,075	5,078	12,203
RAIN.				
Inches	. .	1.09	.25	1.34

CLOUDS—TORNADOES AND ELECTRICITY.

S. A. MAXWELL, MORRISON, ILL.

Many theories have been advanced to account for the marvelous freaks played by tornadoes. Some who have examined into it, have asserted that these frightful storms are caused by the rushing together of two currents of air from different directions; others maintain that the phenomenon itself, and the remarkable circumstances attending, are both due to the action of electricity. In my opinion the holders of both these theories are "partly in the right and partly in the wrong."

Every one is familiar with the little whirlwinds, which are so common in dry, warm weather in the spring. These never occur on cloudy days, for the reason that heat is not generated at the surface of the earth in sufficient quantity to produce ascending currents of air. That there is a strong upward current in the center of the whirl, both in ordinary whirlwinds and in tornadoes, has many times been proved by observation. Where such current is formed, from whatever cause, the tendency is to produce a vacuum at the surface of the earth directly beneath; but this is prevented, since the surrounding air, in obedience to a well-known physical law, rushes in trom all sides, and, finding no other outlet, escapes upward with the ascending current, whose destructive power is thus greatly increased by the additions produced by its own action. The rushing together of these under currents almost invariably causes a rotary or whirling motion, on account, no doubt, of their unequal velocities and densities. This whirling motion is familiar to all; for it is seen in the little eddies, produced where rapid currents in a stream of water mingle with those of slower motion, or with the waters of a stagnant pool. The surface air being warm and moist, in ascending as described, is suddenly cooled, and therefore condensed into a thick cloud, which, on account of the centrifugal force produced by its rotary motion is thrown outward, forming the so-called funnel or tornado cloud. Sometimes the forward movement of this cloud is very rapid, often with a bounding motion, passing for some distance high in air, and anon, descending to the earth, where it destroys everything in its path, —the strongest works of man's genius or mechanical skill, beind demolished in an instant; and trees that have withstood the ordinary storms for ages, at once falj prostrate by a single breath of this irresistable destroyer.

Now the question arises, does electricity play any part in the production of these phenomena? It is a fact that there is a large amount of electricity exhibited during these storms; but I would rather believe that certain peculiar manifestations of electrical action are due to the phenomena above stated,—viz., the mingling of currents, the condensation of vapor, etc., than that the tornado itself is the result of electricity. I think, however, that after the formation of the tornado is complete, there are numerous phenomena caused by the electric force. Every object directly underneath the funnel is electrified, so also is the funnel, but with the opposite kind of electricity. According to Prof, Henry, the base of a cloud is charged with positive, and the surface of the earth with negative electricity. There is a great tendency on the part of electrified substances to rush together if charged with opposite electricities; and conversely, just as strong repellent action when both are positive or both negative. It is also true that any object strongly electrified instantly imparts its own species of electricity to an object in contact with it, and immediately tbrows it off or repels it violently. These facts clearly account for many of the astonishing phenomena, which occur during the passage of the tornado. If we place upon a flat surface, as a table, a lot of iron filings, and pass a magnet along about an inch above them, each little metalic particle will stand upon one of its extremities, and perhaps some of them will rush through the intervening space and attach themselves to the magnet. It is nearly the same phenomena in the tornado:—the objects lying on the earth's surface are the metallic filings, the funnel cloud of the tornado is the magnet. Though the phenomena are similar, in the two instances, there is a vast difference in their effect.

It is said that the stem of the tornado cloud, when extending toward the earth, but not reaching it, sometimes becomes incandescent or apparently red-hot from the electricity which it accumulates. I have never observed this appearence, but many instances have been noted by observers both in this country and in Europe.

These, then, are the conclusions drawn from observation and research concerning the connection of electricity with the tornado. These meteors are less rare than many suppose; for by keeping a careful watch, we, who are residents of the upper Mississippi valley, may see one as often as once in three years. Some tornadoes, however, do little or no damage, passing along a short distance and are then absorbed by the clouds above them, and are seen no more.

As regard tornadoes, they seldom occur in the forenoon, but generally between the hours of two and eight, p. m.—the Tampico (Ill.) tornado, of June 6th, 1874, was, however, an exception to this rule, occurring about 11 o'clock at night;—also, the one at Leavenworth, Kas., May 6th, 1875, which happened at 3:20 in the morning.

It is needless for me to enlarge upon this portion of my subject, since my own views differ so widely from those of the public generally that a proper presentation of them would not be possible in an article intended to be brief. At some future time I trust I shall be able to furnish to the readers of the "Review" an article on tornadoes, which will be more instructive than the one on *Clouds*, which is now brought to a close.

ETHNOLOGY.

THE PUEBLO INDIANS.

JAMES C. PILLING, U. S. BUREAU OF ETHNOLOGY.

The Pueblos of New Mexico and Arizona are towns or villages inhabited by Indians of various races and speaking different languages. When we omit the Indians inhabiting the Middle Gila river, who are also sometimes spoken of as Pueblo Indians, the languages of the others are divisible into four families.

THE SHINÜMO (sometimes called Mòki) speak a language of the Sho-sho-ni-an, considerably differing, however, from the neighboring Pai-Ute, Uta and California dialects of this family. They occupy six of a group of seven Pueblos—the seventh speaking a language of the Téwan—each under its own chief. These are the only Pueblos in Arizona, the remainder being within the limits of New Mexico.

The following authors are known to have written or left manuscripts on this language:

PALMER (Dr.)—Vocabulary of about 200 words (MSS.)

PALMER (Capt. A. D.)—Vocabulary of about 200 words (MSS.)

SIMPSON (J. H.)—Vocabulary of the Moqui; 38 words. [In Journal of a Military Reconnaissance, &c., Wash.: 1850, 8°.] reprinted in

BUSCHMANN (J. C. E.)—"Võlker und Sprachen New Mexicos." Akad. der Wissenschaften. Berlin: 1856, 4°.

LOEW (Oscar)—Vocabulary of about 200 words and some elements of grammar :In Gatschet (A. S.) "Zwölf Sprachen." Weimar: 1876, 8°.

POWELL (Maj. J. W.)—Vocabulary of the Shinümo, taken at Oraibi, one of the Pueblos. (MSS.)

THE ZÜNIAN—Zuñi (pron. Sùnyi), a comprehensive name given to three inhabited, and as many ruined Pueblos in Northwestern New Mexico, south of the Navajo Reservation: Zuñi, Old Zuñi or Cibola (ruined).

The linguistic literature is as follows:

SIMPSON (J. H.)—Vocabulary of Zuñi; about 40 words in "Journal of Military Reconnaissance, &c.," pp. 140–143. Wash. 1850, 8°.

EATON (Capt. J. H.)—Vocabulary, including numerals. (In Schoolcraft, Vol. III., pp. 416–432).

WHIPPLE (Lieut. A. W.)—Vocabulary in Pacific R. R. Rep. III. 2, pp. 91-93.

All the above reprinted in

BUSCHMANN (J. C. E.)—"Völker und Sprachen New Mexicos." Akad. der Wissenchaften. Berlin: 1856, 4°.

PALMER (Dr.)—Vocabulary of about 60 words (MSS).

KLETT (Francis)—The Zuñi Indians of New Mexico. In Popular Science Monthly, N. Y.. 1874, pp. 580-591 (Illus. ethnological).

STEVENSON (J. S.)—List of names given to Zuñi pottery, 1879 (MSS).

KÈRAN.—Kèra, Span. Quera, plur. Qüeres; an ancient name of unknown signification given to Pueblo Indians west of the Rio Grande. Locally they are divided into two branches: 1. A northeastern branch on the Rio Grande, embracing San Felipe, Santo Domingo, Còtchite, Santa Aña and Cìa (Silla, Tse-a). 2. A western branch on the Rio San Juan: Kawaìkome; Laguna, Povate; Hasatch, Mogino.

The linguistic literature is as follows:

SIMPSON (J. H.)—Vocabulary of Kèra, about 30 words. [In "Journal of Military Reconnaissance. &c." Wash.: 1850, pp. 140–143, 8°.]. Reprinted in

DAVIS (W. H. H.)—"El Gringo, or New Mexico and Her People," N. Y., 1857, pp. 157–159, 8°.

WHIPPLE (Lieut. A. W.)—Vocabulary of Kiwomi, about 200 words, and of Cochitemi, about 60 words. [In Pacific R. R. Report III., 2, pp. 86–89.]

The above reprinted in

BUSCHMANN (J. C. E.)—"Võlker und Sprachen, New Mexicos." Akad. der Wissenschaften. Berlin: 1856, 4°.

LOEW (Oscar)—Vocabulary of Santa Aña, about 200 words and a few sentences. [In Gatschet (A. S.) "Zwõlf Sprachen" Weimar, 1870, 8°.

LOEW (Oscar)—Vocabulary in Lagüna. (Ibid.)

KLETT (Francis)—Vocabulary of Acoma, about 60 words, 1873. (MSS.).

WENAUL (John)—Teacher of Laguna; Specimens of Laguna primer and catechism, with interlinear English translation. (MSS.)

TÈWAN.—The largest number of Indian towns in New Mexico, along the Rio Grande, speak dialects of the Tēwan. It seems that in former times these dialects extended far into Texas and Chihuahua along the same river, though only a few scattered remnants of them are now remaining there.

Of this family five main divisions may be made, these being mutually unintelligible:

1. Taño: Isleta; another Isleta near El Paso; Sandìa.
2. Taos: Taos (Indian, Taxē) Picuni.
3. Jemes: Jemes (old Pecos is consolidated with it).
4. Tewa or Tehua ("house, houses") San Ildefonso, San Juan, Pojoaque,

Nambe, Tesuque, Santa Clara and one of the Moki Pueblos. Of these Pueblos, Santa Clara is the only one located on the western bank of the Rio Grande.

5. Piro in Sinecù, south of El Paso.

LINGUISTIC LITERATURE.—SIMPSON (J. H.)—Vocabulary of Jemes, etc., 30 words, pp. 140–143; reprinted in Davis' "El Gringo."

WHITING (David V.)—Vocabulary of Tesuque, about 400 words. [In Schoolcraft III, 446–450.]

The above reprinted in

BUSCHMANN (J. C. E.)—"Võlker und Sprachen." Berlin: 1856, 4°.

LOEW (Oscar)—Isleta, Jemes, San Ildefonso, San Juan. Vocabulary of about 230 words each, and sentences from Tesuque (about fifty). [In Gatschet (A. S.) "Zwõlf Sprachen." Weimar: 1870, 8°.

PALMER (Doctor)—Vocabulary of Taowa (MSS.)

BARTLETT (J. R.)—Vocabularies of Piro, of Sinecù, of Tigua (viz: Tèhua, Tewa. MSS.)

YARROW (Dr. H. C.)—Vocabulary of Los Lüceros. (MSS).

YARROW (Dr. H. C.)—Vocabulary of Los Taos. In Gatschet (A. S.) "Zwõlf Sprachen." Weimar: 1870, 8°.

KANTZ (Aug V.)—Vocabulary of Isleta, 1869. (MSS.)

GIBBS (Geo.)—Vocabulary of Isleta, 1868. (MSS.)

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, January 1, 1881.

The problem of prehistoric times—of primitive man, is a modern problem, and one which has provoked a passionate interest even in spheres outside science, because everybody feels that with the question of our origin is tied in some sort by a thousand cords—not only that of our actual, but of our future destiny. The ideas of transformation since ten years have made astonishing progress; but in their wake have also followed exaggerations; the Germans, in pushing theories to their utmost limit, have only arrived to be absurd. At present there is a kind of relative calm on the part of those who study seriously the delicate question of the origin of animals; they find themselves in the face of questions unsolved—that changing the place of a miracle does not resolve it, and that in all phenomena science halts in the presence of the inexplicable. Those who desire to approach the grave matters in question, in this spirit, cannot do better than read M. de Nadaillac's two volumes on *Les Premiers Hommes*. It is a calm, impartial and independent examination of all the evidence and discoveries known, up to the present. Man—yes or no; has he lived during the tertiary period? That's the question. There are scientists who would place the origin of man not only in the pliocene, but the miocene, and even the eocene periods—a classification of the tertiary formation made fifty years ago by Sir Charles Lyell, and founded on the variable proportion of shells of species still living, mixed at the same time with others fossilized. As negative are not of the same value as positive proofs, there are geologists who see in cut flints and bones conclusive evidence of man's antiquity. Now, in the first place, are these objects contemporary with the strata in which they have been found; secondly, is it absolute certainty that these objects have been manipulated by a human being? It is in the fauna immediately following the pliocene period that the flint existence of man, it is generally admitted, is to be found. The first traces of man in Western Europe are flints simply broken, not fashioned, and of a nature to serve immediate wants; he lived in a *milieu* of strange fauna, where the animals of northern, temperate and southern zones were associated. The Abbe Bourgeois has discovered an immense number of small cut flints, and has, accordingly, placed man in the miocene period. Respecting this, M. de Nadaille pertinently asks, of what use these remarkably small flints could be to man, cut, as they must have been, with much effort and great labor; they were useless either for attack or defense, and still less for an implement or a tool. Neither have the alleged discoveries of human bones in tertiary strata been confirmed when subjected to rigorous analysis. The origin of humanity is still shrouded in mystery; paleontology and zoölogy, no more than geology, have yet found out the exact cradle of our species, nor to link it to some other anterior species. There are points of union which have escaped demonstration; there are veritable *lacunes* which render classification difficult; there are variations impossible to explain. These remarks do not touch what is in the man—the supreme form of indifference, intelligence, articulated language, perfectibility.

Professor Fredericy, of Liege, has investigated the subject of the coagulation of the blood. Extracted from the organism, blood solidifies, forms a mass called fibrine; the same remark applies to lymph. Before coagulation, blood consists of globule and a liquid called plasma; after coagulation of globules, serum and fibrine. Deprived of the latter, the blood does not coagulate. If blood be beaten up or whisked with a piece of whalebone, in a vessel, the fibrous masses will adhere to the rod, while the serum, holding the globules in suspension, will remain liquid. This is the process employed in the slaughter houses to prevent the coagulation of pigs' blood, so essential for making black puddings. But from where comes this fibrine? It cannot be attributed to the new conditions in which it is placed, for neither cold, air, nor rest, nor the combination of the three can explain the phenomena. The principle of coagulation coming, not from an external cause, is it to be attributed to an internal one? So long as blood is in contact with the coats of the vein, etc., it will not coagulate—for a long time. Even in dead bodies, the blood is only imperfectly coagulated. But if a foreign body be introduced into the vein coagulation will set in. Since the end of the sixteenth century it has been known that it is in the liquid part of the blood—the plasma—and not in the red globules, that the generation of fibrine must be found, and the commencement of the formation of fibrine is always marked by the agglutination of several white globules. Now, according to Schmidt, these white globules form a ferment of fibrine; this ferment does not exist in the blood during circulation; it is formed the moment the blood quits the vessels and comes in contact with foreign bodies; it is derived from the white globules, hence the ferment does not exist whilst the blood circulates; if the ferment be injected into the veins of a living animal, it is quickly destroyed. The white globules, on leaving the blood and coming into contact with a foreign body, are irritated, and that produces the ferment.

M. Engineer Roche has published a very interesting report on the Trans-Saharian railway, by which France is studying to connect her colonies at the Laborn and Sivegne with Algeria. No difficulties exist under the heads of sandhills and water; the latter "will be found in all the Sahara in sufficient quantity for the wants of the railway." The construction of the line will be extremely easy: the soil will be the ballast; no masonry work will be required. The only difficulty is the want of coal, which must be brought from the seaside. M. Roche does not despair of utilizing the solar heat, by means of the apparatus Mouchot, or rather reflector, indirectly, of course, with compressed air.

M. Delisrain has concluded his examination of the origin of carbon in vegetables; it is the chlorophyll cell which reduces the carbonic acid, and so elaborates the organic matter; the latter cannot enter into circulation, according to some authorities, unless it be a second time burned.

M. Panchon's careful experiments on the influence of light on germination, are very interesting. He has found that the lighter the grain the more rapidly it germinates. Owing to the difficulty of not having identical volumes of heat, for two different seeds, no serious comparison under the head of temperature could be made. Light exercises an influence more or less accentuated on germination, by forming the absorption of oxygen; heat diminishes the importance of the influence of light, but the quantity of oxygen absorbed augments with the elevation of the external temperature. More carbonic acid is given off during obscurity; the latter would appear to be in some cases a condition favorable to the development of certain seeds.

It was an old doctrine, because taught by his parents, that epidemics are influenced by the seasons, the soil, atmosphere, cold, heat and humidity. The doctrine was overthrown by Broussais, who placed all the disease in the subject in the evolution of the morbific element, and that nothing but the medical treatment could modify. A reaction has set in; it is now considered a truism that there is a close connection between epidemics and climatic influences. Since twenty years Dr. Besnier has been delegated by the Medical Society of Paris to collect and study all the facts bearing on the point. Typhoid fever is a morbid type to be met with in every country, with all human races, and at every epoch of the year. France is the classic land of this disease and Paris its head center. Naturally, Dr. Besnier has concentrated his attention on Paris, where one-twelfth of the deaths, or 1,200 per year, are due to typhoid fever. Now the number of these deaths are not regularly divided as to the seasons—during spring the deaths from the malady are less than one-half what they are in autumn; the maximum of mortality is during the months of July and October; twelve per cent. of the persons afflicted with typhoid fever succumb—that is to say, eighty-eight are cured. To well combat the fever not only the diagnosis ought to study the individuality of the patient, the intensity of the disease, but also the season—summer temperature develops while augmenting the malady, and autumn maintains it in its aggravated form. Atmospheric influences, concludes the Doctor, are momentous factors in typhoid fever, but they do not produce all their effects nor become fruitful, only when encountering local and individual conditions of a favorable character.

Sydenham said that if any one would devote his life to finding a cure for corns, he would merit the thanks of posterity and of humanity at large. The skin is a soft, delicate membrane, very elastic; its color is rose with the infant and with the adult, following individuality, race, climate and season; it is very fine on the eyelids, but relatively thick on the palm of the hands and the soles of the feet. Skin consists of two layers—epidermis and the other more profound; the dermis. Everywhere there is a section of unctuous matter save on the palm of the hands and the sole of the foot; it is by the orifices that the perspiration exudes. A corn is a superficial tumor on the epidermis, with a root which penetrates more or less profoundly into the dermis—often deeper still; hence, why the ancients called corns *clavi pedum*, or feet nails, on account of their resemblance to ordinary nails. The *welt* is the commonest form of a corn; it is a combination of layers of the epidermis produced by unequal pressure of a boot or the irregular plait of a stocking; it is also the result of professional work. The monks that wear sandals are martyrs to such corns. A welt differs from a corn in being on the surface, where it always remains; the corn is conical and pierces downward; often certain of these excrescences become deformities. In 1599, Marshal Lavardin brought to Paris a man having a horn on his head as long as a goat's; in 1855 there was a Polish girl, aged 15, who had sixteen corns growing on different parts of her body—one springing even from the knee. Dr. Decaisne says that, relatively, our feet are not less deformed than those of Chinese ladies—the imprisonment of the foot being only the difference of degrees. Paring is the cure for welts; extraction for corns; caustic agencies ought to be avoided.—F. C.

Lieut. R. M. Berry, of the United States navy, has been ordered to command the steamer Mary and Helen on the proposed Arctic expedition in search of the Jeannette. Secretary Hunt furnished Lieut. Berry with a list of the naval officers who volunteered for the service, and he will be guided by any preferences he may entertain in the make-up of the detail of officers who will serve under him.

BOOK NOTICES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. Part III, October to December, 1880; pp. 457, 8vo.

For a period of nearly seventy years this academy has maintained its existence. It has published more than fifty volumes of its Journal. Transactions, besides other works written by its members as contributions to science. Among the most active members at present are Professors Leidy and Meehan, Doctor Harrison, Rev. H. C. McCook and Messrs. Martindale, Potts and Heilprin, all of whom have contributed to the present volume the results of original investigation in botany, zoölogy, etc. At the election held at the close of the year, most of the officers were re-elected, including the able and experienced president, Dr. Ruschenberger, the zealous and attentive secretary and librarian, Dr. Edward J. Nolan, and others who have served faithfully for many years.

THE ROMANCE OF ASTRONOMY. By A. Kalley Miller, M. A.; quarto; pp. 28, J. Fitzgerald & Co., N. Y., 15c.

This is number 20, volume I, of the Humboldt Library, and, as usual, is an interesting and instructive number, comprising a popular account of the Planets Astrology, The Moon, The Sun, The Comets, La Place's Nebular Hypothesis, The Stars, The Nebulæ, The Past History of Our Moon, Ancient Babylonian Astronomy—the last two written by Prof. R. A. Proctor.

A STUDY OF THE SAVAGE WEAPONS AT THE CENTENNIAL EXHIBITION. By Edward H. Knight, A. M., LL. D., 8vo.; pp. 85.

We are indebted to Professor Otis T. Mason, of Columbian College, Washington, D. C., for this volume, which comprises simply an account of one class of objects shown at the Centennial Exhibition at Philadelphia in 1876,

Inasmuch as there was no concurrence of design on the part of the various exhibitors from all parts of the world in presenting these specimens of savage weapons, and they were mainly thrown in, as it were, with other objects, as curiosities, it is highly creditable to Doctor Knight that he has been able to classify them and illustrate so well by them the ethnology of the tribes formerly using them. There are nearly one hundred and fifty engravings, representing the weapons of all nations in all stages, while the text is graphically descriptive of all. People who have any taste for ethnological studies, will be much pleased and instructed by a perusal of this work.

THE SCHOOL BULLETINS. Published by C. W. Bardeen, Syracuse, N. Y., 1881.

These include the New York Examination Questions, 25c; Suggestions for Teaching Fractions, by W. W. Davis, 25c, and a List of the Regents Schools of the State of New York with names of the Principals, 25c, and will be found very useful to school boards and teachers in all classes of schools.

OTHER PUBLICATONS RECEIVED.

Our Home and Science Gossip; No. 4, Vol. V, March, 1881, 4to 16 pp., Rockford, Ill., $1 per annum. The Dial; a monthly index of current literature, Jansen, McClurg & Co., Chicago, 4to, pp. 24, $1 per annum; Report of Atmospheric Physics, by N. E. Ballou, M.D., Sandwich, Ill.; Pueblo Pottery (illustrated), by Prof. F. W. Putnam, 4to, 14 pp. Scientific News, No. 3, Vol. I., Munn & Co., New York, $1.50 per annum; Botanical Index, L. B. Case, Rich_mond, Ind., monthly, 50c. Population and Resources of Alaska; a report of Ivan Petroff, special agent of Census Bureau, Dec., 1880, 8vo, pp. 86. American Kindergarten Magazine, Vol. 3, No. 11, March, 1881, Emily M. Coe, N. Y. monthly, $1 per annum; The Platonist, Vol. 1, No. 1, February, 1881, Thos. M. Johnson, Osceola, Mo., $2 per annum; The Illustrated Cosmos, Chicago, Ill., Vol. 1, No. 2; $1.50.

SCIENTIFIC MISCELLANY.

NOTES AND QUERIES.

The Historical Magazine for April 1861 has an article on Dr. A. Waldo, a surgeon in the Revolutionary war in which occurs the following: "He left numerous writing on professional subjects, illustrated with well executed drawings. * * * * * * * * * These writings are to-day in the State of Missouri, fifty miles beyond St. Louis." Are these writings still preserved, and if so, in whose possession are they.

ANTIQUARY.

Can any one give me the origin of the name Chariton? It is the name of one of the largest rivers in the State and one of the most populous counties, but its origin seems to be in doubt.

J.

The name of Manuel Lisa or Liza appears frequently in the accounts of expeditions among the Indians of Missouri and up the Missouri river eighty or ninety years ago. From these accounts it would appear he had extensive dealings with the Osage Indians. Are any of his descendants or relatives now living, and if so are they possessed of any of his papers in which mention is made of transactions with the Osages?

OSAGE.

Edward G. Mason, in his article on Kaskaskia, published in the Magazine of American History for March, 1881, says: "On the 18th of December, 1727, died Zebedee Le Jeune Donni, of the Reverend Jesuit Fathers," * * * * * * And in the next paragraph the following: "Among the witnesses who sign are * * * * * * and Zebedee Le Jeune, the priest whose death in 1727 is noted in the burial register." Was there a priest at Kaskaskia of this name or was he a *donne* or given man. His name does not appear in Shea's History of the Catholic Missions in America. ILLINOIS.

Will some student of our early history refer me to the volume where the particulars of the French expedition, which is said by Switzler and other historians of our state to have ascended the Missouri as far as the mouth of the Kansas in 1705, are to be found. W. H.

I am astonished at hearing the noon steam-whistle from Topeka quite often and distinctly here—25 miles away. For the past week their time has been fifteen minutes ahead of our farm time. Are sound waves often so widely distributed? J. S.

Sir Edward Thornton, in his reply, March 11, '81, to a communication from the New York Produce Exchange, says: "That trichina spiralis exists among hogs in the United States, and that some individuals have died from eating pork containing that insect, seems to have been proven." Is trichina spiralis an *insect?* L.

AGASSIZ.

PROF. T. BERRY SMITH—1874.

Oh, why so still, thou great and wondrous man?
Unfold those hands, and ope' those sleeping eyes,
And, breaking silence, speak again to me
About the earth and all that therein is.
They tell me he is dead. But is he dead?
His body's dead, indeed; but what was it
Except the dwelling place of restless mind
Which, all the while it lived within these walls,
Was reaching out and panting to be free?
He is not dead—Agassiz cannot die.
Long years ago his little bark was one
Of a great fleet that sailed along the shores
Which bound life's stormy ocean. Bolder grown
And with a daring heart, he left the throng
And sought the vaster deep. There, far beyond
The lines that marked his chart, fearless he ran;

And, as his prow broke up the ancient deep
And ploughed the unknown sea, the surges rose
Behind the driving wheels and sped away
Toward the far off shores. And yet they speed
And will, till time is over.
Master in Science!
Father of many a thought that, till thy birth,
In Nature's vault had lain, and no one knew
The key to ope'the door. At the command
The ponderous bolts flew back, and gates now first
Unbarred, wide open swung; and while they turned
The view disclosing more, thine eager soul
With lustrous eye peered in and caught the gleam
That shot from many a gem. The briny sea
From out its unseen depths gave up a hoard
Of new and wondrous things, when thy long arm
Beneath the waves reached downward, grasping the fields
That base the nether deep. And ancient earth,
"The mother of all living," gave up her dead—
The long lost tribes that were in primal years
And are not now, nor any semblance bear
To all that live upon this later stage—
Whose bones thou saw'st and all the form restored
Or from a trace drew out the perfect whole.
Agassiz dead? Agassiz cannot die.
'Twas at his wish the unknown sea gave up,
And earth its caverns ope'd that he might gaze
Upon her treasured wealth.
The voiceless past
Once more took up its harp, and smote, and sang;
The thrills that ran across its chords were sweet,
The language long forgot, but echoing hills
Along the shore of time the music caught
And carried to his ears. He listened long
At the exultant strains, and then the words
Proclaimed to all the earth, wishing the tribes
That dwell to-day to be ecstatic too.

THE EARTHQUAKE AT ISCHIA.

The earthquake, which a week ago shook Ischia to its foundations, has desolated an island at once beautiful and historic. At the western entrance of the Bay of Naples, about twenty miles from the mole, the view from its shore is one of the loveliest in the world. The blue sky overhead, reflected in the blue waves beneath, seems fairer to the traveler than any other spot on earth, and when he has walked nine miles inland and climbed the lofty hill Mount Eponeo, as it is now called, he sees stretching far into the distance the long indented line of the Italian mainland. Procida and other smaller islets are beneath his feet, and pleasure boats and fishing smacks, their white sails lazily flapping in the light breeze, creep out upon the dancing waters from hundreds of villages clustering round the inlets far and near. It is a scene to entrance a poet, but not from its intrinsic beauty only. All the charms of old association are gathered thickly round it. Ulysses himself was there when the dawn of history was but passing into the morning hours, and it has been consecrated by the immortal verses of both Homer and Virgil. In later days Berkely, the most imaginative and sensitive philosopher since the days of Plato, declared that Ischia was an epitome of the whole earth, and the visitor on descending the mount in the center might easily fancy that the golden age had returned and that the flaming sword had once again been removed from the gates of Eden. Grapevines cover the gentle slopes of the many hills, groves of chestnuts and thickets of myrtle crown their tops. Wheat and maize enrich the valleys, and the most exquisite fruit tempts the hand on every side. Apricots, peaches, oranges, limes, pomegranates, figs and melons attest the richness of the soil and the general beneficence of the climate. Nor does languor, as in so many southern lands, step in to clog the full enjoyment of all this wondrous loveliness and luxuriant profusion. Even in the height of summer the delicious and cooling sea breezes pour a constant fountain of new vigor into the frame of the people.

So unrivaled a situation has attracted thousands to Ischia. In the early years of the sixteenth century three celebrated women simultaneously selected it for their temporary home. Joanna, of Naples; Berenice, the widow of the great Matthais Corvinus, and Isabella, the widow of Gian Galeazzo, lived near together, and a quarter of a century afterward Vittoria Colonna, the widow of the hero of Pavia, made it her residence. There she wrote her pathetic poems in honor of the memory of the husband she had lost. Hers was one of the greatest female intellects of the middle ages, and the echoes of her song made Ischia famous throughout Europe. When Ariosto and Michael Angelo spoke or wrote of her and her works, they dwelt also with rapture upon the landscape in the midst of which her genius ripened into such splendid blossom. And as time went on, noble men and beautiful women, and poets and artists of all nations, have delighted to haunt the spot for a while and celebrate it with voice, with pen or with brush. But ever in the background of time, the remembrance of a specter of dread days that had been, never passed away. The island itself was undoubtedly of volcanic origin, and, indeed, during the many years in which Vesuvius slumbered until she again awoke into action amid all the horrors that overwhelmed Pompeii and Herculaneum, it was believed to be a safety valve for the subterranean fires raging beneath in the bowels of the earth. As in other lands parents tell their children tales of fairyland, so in this Ischia, wreathed as it seemed with smiles that could never fade, the folk lore was tinged by never so slight a tint drawn from the volcanic devastation so far by-gone that to the simple villagers it has ever been included in that mysterious era of "once upon a time" so familiar to the tales of our own childhood. But now the dim tradition has become a sad reality. The earthquake which none can foresee, but in the presence of whose resistless force the boldest tremble, has brought ruin again upon the island; and 3,000 people, but ten days ago so happy in their earthly Paradise, are seeking the bodies of the killed or wandering to and fro homeless in the land.—*Globe-Democrat.*

RAILROAD AND TELEGRAPH LAND GRANTS.

The following is an official statement of public lands which have been granted by Congress to aid in the construction of railroad and telegraph lines:

Gulf and Ship Island Railroad, Mississippi, granted 1856, 652,800 acres.

Alabama and Florida Railroad, Alabama and Florida, granted 1856, 419,-520 acres.

Coosa and Tennessee, Alabama, granted 1856, 132,480 acres.

Mobile and Girard, Alabama, granted 1856, 840,880 acres.

Coosa and Chattanooga, Alabama, granted 1856, 150,000 acres.

Alabama and Chattanooga, formerly Northeast and Southwest Alabama and Mills Valley Railroad, Alabama, granted 1856, extended, 1869, 897,920 acres.

Pensacola and Georgia, Florida, granted 1856, 1,568,729 acres.

Florida, Atlantic and Gulf Central, Florida, granted 1856, 183,153 acres.

North Louisiana and Texas, formerly Vicksburg, Shreveport and Texas, Louisiana, granted 1856, 610,880 acres.

New Orleans, Baton Rouge and Vicksburg, Louisiana, granted 1871, 3,800,-000 acres.

St. Louis and Iron Mountain, Missouri, granted 1866, 640,000 acres.

Little Rock and Fort Smith, Ark., Arkansas and Missouri, granted 1856, 1,-009,296 acres.

Detroit and Milwaukee, Michigan, granted 1856, 355,420 acres.

Houghton and Ontonagon, formerly Marquette and Ontonagon, Michigan, granted 1856, extended 1864 and 1868, 522,575 acres.

North Wisconsin, formerly LaCrosse, Lake Superior and Branch to Bayfield, Wisconsin, granted 1856 and 1864, extended 1864, 1,408,455 acres.

Wisconsin Central, formerly Portage, Winnebago and Superior, Wisconsin, granted 1864, extended 1874, 1,800,000 acres.

St. Paul and Pacific, St. Vincent extension, formerly branch to Red River of the North, Minnesota, granted 1857 and 1865, extended 1873 and 1874, 2,000,-000 acres.

St. Paul and Pacific, Brainerd branch, formerly branch to Lake Superior, Minnesota, granted 1862 and 1865, extended 1873 and 1874, 1,475,000 acres.

Hastings and Dakota, Minnesota, granted 1866, 530,000 acres.

Oregon Central, Oregon, granted 1870, 1,200,000 acres.

Atlantic and Pacific, various States, granted 1866, 42,000,000 acres.
Texas Pacific, various States, granted 1868 and 1874, 18,000,000 acres.
Northern Pacific, various States, granted 1864, 47,000,000 acres.

SEPARATING GOLD, SILVER, AND COPPER ALLOY BY ELECTROLYSIS.

Among the later inventions well worthy of the attention of metallurgists, is the electrolytical process of refining, patented by E. André, both in this country and in Europe. This process has not been practically applied in this country, but is said to be in operation at the copper works of Messrs. Mason & Elkington, Pembrey, South Wales; at Birmingham and Manchester, England; the government works at Mahsfeld, Ocker, and Duisburg, Germany, and the refining works at Hamburg and Frankfort-on-the-Main. The results obtained at these works are said to be of the most satisfactory nature, and with the improvements of the dynamo-electro machine, which are continually making, even better results are expected in the future. This process is said to completely extract, more economically than by other means, the precious metals from their base alloys, and separate the latter in a chemically pure metallic form. Mr. André employs the current of the dynamo-electric machine on the material to be separated as anodes suspended in diaphragms in a diluted acid or alkaline bath, according to circumstances. When the disintegration of the alloys occurs, the precious metals are retained in the diaphragms, and the baser metals are deposited in a pure metallic state upon the cathodes placed opposite the anodes. The bath is changed at proper times, to free it from accumulated impurities, such as zinc, iron, antimony, etc. —*Engineering and Mining Journal.*

MISSOURI WATER POWER.

Had Missouri been peopled for the last sixty years by the overflow of population from New England, she would doubtless be a manufacturing prodigy. The motors with which nature has furnished her so lavishly, would by this time have been turned to full account, and would be famous as the agents of an enormous productiveness in a great variety of lines. No eastern State is credited with having such an aggregate volume of available water power as investigation shows Missouri to possess. Yet her labyrinth of rapid dashing streams, and her multitude of perennial springs, have scarcely any reputation away from their own neighborhoods. Probably few Missourians have an adequate conception of the amount of energy which is daily going to waste through the State, in the shape of unused but valuable water power. But only when Missouri is thoroughly canvassed can the possessions of her 113 counties be fully realized.

The southern half of the State is abundantly supplied with large springs; yet taking the State over, there is seldom a section of land without its overflowing fountain of water. The one called Bryce's spring, on the Niangua river is probably the largest. It discharges 10,927,000 cubic feet per diem, and flows away, a swift stream forty-two yards wide. Its temperature is steady at 60° Fah., and ice never forms near it to impede machinery. Its flow is regular, so that the machinist can know just what power to depend upon the year round. Upon the upper courses of eleven Missouri rivers, most of which are more or less navigable, fine water powers are to be found at intervals of from one or two to five, ten or fifteen miles. True, to make these powers available, the rough descents where they exist would generally need to be supplemented by the usual artificial appliances, such as dams or means of confining the channel to a narrow space; but happily, at these rapids the beds of the streams are invariably rocky, thus affording a sure foundation. Though the average annual rainfall of the State is forty-one inches, springs constitute the reliance of our streams for a steadfast flow of water. Several hundred springs are known to be large and forcible enough to supply the power required to run an ordinary mill or factory.—*The Age of Steel.*

TRICHINÆ IN MAN.

It has been previously stated, that for some thirty years subsequent to the first description of the capsule by Hilton, and some twenty-five years after the identification of the parasite itself in man, the same were looked upon as mere harmless curiosities, and, that, although Leidy discovered the parasite in the flesh of swine in 1847, still it was not until 1860 that the connection was established between them, appearing, as they had, in two totally different species (men and swine). The honor of this important discovery belongs to Dr. Zenker, of Dresden, Germany. The disease was discovered in a servant-girl admitted as a typhus patient to the City Hospital in Dresden. She died, and her flesh was found to be completely infested with trichinæ.

Leuckart's and other experiments have shown that a temperature of 140° F. is necessary to securely render trichinæ inert. Direct heat applied to the slides holding specimens of trichinous pork, by means of the Shultz heating-table, has demonstrated, under the microscope, that a temperature of 50° C. (122° F.) is necessary to the certain death of the trichinæ.

Leisering's experiments with trichinous pork, made up into sausage-meat and cooked twenty minutes, gave positive results when fed to one rabbit, and negative by another. He sums up his experiments as follows:

1. Trichinæ are killed by long-continued salting of infected meat, and also by subjecting the same for twenty-four hours to the action of smoke in a heated chamber.

2. They are not killed by means of *cold* smoking for a period of three days, and it also appears that twenty minutes cooking freshly prepared sausage-meat is sufficient to kill them in all cases.

The various kinds of cooking, however, are quite different in their effects on trichinous pork. Frying and broiling are most efficient, roasting coming next. Boiling coagulates the albumen on the outer surface, and allows the heat to penetrate less readily; it should be kept up, therefore, for at least two hours for large pieces of meat. Whether boiled, broiled or fried, pork should always be thoroughly cooked.

Practically speaking, the cooking, salting and hot smoking which pork in its various forms receives in the United States, must be in the vast majority of cases sufficient to kill the trichinæ and prevent infection of the persons consuming the meat. Epidemics like those reported in Germany are unknown here, and trichiniasis in a fatal form is undoubtedly a rare disease. In the vicinity of the great pork packing establishments near Boston, the "spare.ribs," containing the inter-costal muscles, are very largely bought and eaten by the people near by; and trichiniasis among them has not in a single case been reported, so far as I have been able to learn. The *cuts* being thin and well cooked, any trichinæ in them are quite certain to be killed. Even when trichinæ are introduced into the intestinal canals too, they are sometimes expelled by diarrhœa, and the invasion of the system by a small number does no harm.—*American Microscopical Journal.*

That predjudice against "them litery fellers," which in this country identifies statesmanship with ignorance, will be shocked to learn that one of the last performances of the author of Lothair before resigning office was to make Owen Meredith an Earl, under the title of Earl Lytton, of Lytton and Viscount Knebworth. The new fellows who come in are almost all of them literary. Gladstone is a voluminous writer, the Duke of Argyle is as proud of his literary record as he is of being the Macallum-More, Lord Selborne has condescended to edit a hymn book, and a very good hymn book it is, too, Vernon-Harcourt used to write for the *Saturday Review*, Foster has written a life of William Penn, Earl Granville is a man of great linguistic attainments, and, taken altogether, the new Ministry, admittedly one of the strongest in point of statesmanship and political influence that England has known for years, is undoubtedly the strongest in point of literary attainments and in the record of authorship among its members.

SCIENCE IN THE SCHOOLS OF FRANCE.

The modifications in the course of studies in the French public schools, recently decreed by the Superior Council, give to scientific teaching a more prominent place than has hitherto been allowed it, especially in the elementary classes. In the seventh class, the elements of the natural history of animals and plants are added to the history of soils and stones, and take preference over it, as offering more interest to children and being of more practical utility. In the sixth class an hour is deducted from the ten devoted to Latin and added to those given to the sciences, which are allowed four hours a week. In the fifth class, where scientific instruction has been obviously deficient, the hours for Latin are reduced to five, and the sciences are given four hours. In the fourth class an hour is taken from Greek, and the hours for scientific instruction are increased to four. Scientific instruction will be continued in the third, second, and rhetorical classes without encroaching upon the other courses, an hour being taken from the study-hours for new subjects of natural history in the third class, for physics in the second class, and for subjects of physics which have not been previously entered upon by the pupils, in the rhetorical class. The Superior Council advises that the teaching of mathematics and the natural sciences in the grammar-classes be committed to special professors whenever the funds of the school will permit it and suitable teachers can be obtained; otherwise, professors of science in the higher classes may perform the duty for an additional compensation; or, if there is no other way, the ordinary professor may provisionally give the special instruction.—*Popular Science Monthly*, March, 1881.

CREDIT TO THE U. S. SIGNAL SERVICE.

The violent storm of the last two days, with its destructive gales and floods, naturally invites attention to the present condition of scientific weather wisdom in this country. On Tuesday last we published the following telegram from New York: "A dangerous storm is crossing north of latitude forty-five degrees; will arrive on the British and Norwegian—possibly affecting the north French—coasts between the 27th and 29th, attended by strong south winds, veering to north-west gales, rain and snow in north; low temperature follows. Atlantic very stormy." This time, at least, the forecast has fulfilled itself almost to the letter, only the prophesied storm seems to have traveled across the Atlantic a little quicker than was calculated, for it began on Tuesday afternoon, and seems to have reached its utmost violence some time during the night of Wednesday. From all parts of the country reports reach us of the violence of the wind and the violence of the rain. Off the mouth of the Tyne, and even within its still treacherous harbor, several wrecks have occurred, resulting in a lamentable loss of life. At Falmouth, at the other end of the kingdom, vessels are putting in almost dismantled by the terrible force of the sea. From Edinburg and Southampton, from Brighton and Liverpool, similar accounts are sent, while in the interior continuous rainfall is producing disastrous floods in all directions. At Wenlock, in Shropshire, the line of railway has been bodily washed away, and all traffic is suspended, while the gas supply of the town is cut off by an inundation which has invaded the gas works. Retford is threatened with the same fate. At Walsall, water lies seven or eight feet deep at the railway station, and the traffic of the trains is stopped. Leeds is buried in snow and Leicester is overwhelmed with floods, while all over the Midlands water covers the meadows, and in some places the housetops are concealed beneath the floods. It is almost unnecessary to say that in such circumstances Oxford lies, like Venice, in the midst of a vast lagoon. The phenomenon is so familiar as hardly to excite comment, still less indignation, although it is perfectly well known that the perpetual inundations of the Upper Thames Valley are largely due to causes which, if not removable, are susceptible of very considerable control. The effect of over thirty-six hours' heavy and almost continuous rain is felt, however, in all parts of the country, almost as much as in the over-burdened Thames Valley. Certainly the American forecast seems in this case to have been very abundantly justified. The coincidence is at least remarkable enough to make a deep impression on the popular mind and imagination, even if professed meteorologists should see reason to doubt whether there is any direct connection between the storm which left the American continent on Monday and the gale and deluge which burst with such violence over our own islands before the end of Tuesday.—*London Times*, *October 20.*

A PROJECT FOR THE YEAR 2000.

Lake Mackenzie is one of those "possibilities of North America" recently suggested. The lake would result from a proposed closing of the northerly outlet of the valley of the Mackenzie River, at the line 68° north, and storing up the water of 1,260,000 square miles. And to this could be added the water of other large areas. It would be a lake of about 2,000 miles in length by about 200 of average width. Its surface would have an altitude of about 650 feet above sea level. It would cover with one continuous surface the labyrinth of streams and lakes which now occupy the Mackenzie Valley. It would be a never failing feeder for the Mississippi. It would connect with Hudson Bay and with the "great lakes," and also with the interior of Alaska by connecting with the Yukon and its affluents. By concurrent results and other "possibilities" it would become, during some months of each year, a navigable water, adding not less than 12,000 miles of communication to the Mississippi. It would complete the interior lines of river courses by connecting them. Cutting the "divide" which now exists between the Mississippi and Mackenzie would do this. The work is small when measured by its results, and it becomes easy of accomplishment under the methods proposed. The connecting of the Upper Mississippi with the proposed Lake Mackenzie would be easily made if that lake had a surface at the proposed altitude of 650 feet above the sea. The outflow from such a lake, having a length of more than 2,000 miles from south to north, and draining a very wide range of altitudes and latitudes, would be a timely and enduring one. This lake would make possible and easy the straightening of the Lower Mississippi. It would also contribute to the proposed ship channel from Cairo, Ill., to the Gulf of St. Lawrence, by the almost straight line which cuts the Wabash Valley, the Lakes Erie and Ontario, and the Lower St. Lawrence. This commercial channel, receiving all the waters converging at Cairo, would complete the demand for a constantly open ship cannel from the St. Lawrence to the sea by way of the Strait of Belle Isle. That demand can be complied with, and the shortest and best line of communication can be thus opened between the interior and the seaboard.—*St. Louis Republican.*

SMOKELESS FUEL FROM COAL.

Mr. W. D. Scott-Moncrieff, in a paper read before the Society of Arts, has recently brought to the attention of that body an important project for not only hereafter preventing, but also for rendering commercially available the dense stratum of smoke that has so long hung like a pall over the city of London, obscuring the light and rendering the atmosphere dangerous to the whole community. He proposes to substitute for the bituminous coal now in universal use for domestic and industrial purposes a modified form of this coal from which the gas has been partially extracted. Experiments made by him as long as ten years ago showed that a semi-coke, resulting from a short distillation of coal, furnishes a fuel that is practically smokeless; and he has since discovered that, treating this coke with water when hot, renders it still more smokeless and makes it the most perfect fuel imaginable, as it has all the cheerfulness and heat-giving properties of the unprepared coal, with none of the disadvantages arising from its use. To produce this fuel in quantities suitable for public use he proposes to take advantage of the existing plant of the gas companies, finding that they are amply sufficient for the purpose. Instead of taking 10,000 cubic feet of gas per ton from the coal, he would take 3,333 cubic feet, or any other convenient proportion, and pass three times the quantity through the retorts. In this manner the gas would be coming away from the retorts all day long, just as formerly, with a slight loss of time to be allowed for the additional frequency of the charging. The supply at the end of the twenty-four hours would be in excess of that which is obtained from the long extraction, and in this way less and not more plant would be necessary to give the same quantity in a given time while the gas itself would be of better quality. The author claims, from his investigations and experiments, that the results of the application of his scheme would prove startling. The gas companies would have double the quantity of by-products, in the shape of tar and ammoniacal products, that they have at present; the community would have twenty-four candle instead of sixteen candle gas; the fuel resulting from the process would be of a nature to ignite readily, make a cheerful fire that gives out twenty per cent. more heat than common coal; and London would become a smokeless city. The only extra expense to the companies would be that of the additional workmen employed in charging the retorts and interest upon the additional capital required for transit appliances; but, as an offset, the the companies would receive an increased quantity of valuable by-products and a supply of fuel that would be in universal demand; and the profits from the sale of this at prices much below that of coal would be such that the companies would be actually getting their coal for nothing.—*Age of Steel.*

LIFE WITHIN THE ARCTIC CIRCLE.

The following extracts from the narative of Mr. Leigh Smith's voyage to Franz Joseph Land last season (1880) show the abundance of animal and vegetable life, as far north as it has been possible for vessels to reach in that direction:

* * * * * * * * *

May Island, Long. 53° 40′ E., Lat. 80° N., Aug. 14, 1880:

Several walruses were seen on some ice to the eastward, and Mr. Leigh Smith, with Captain Lofley and the Doctor went in chase, while Mr Grant and the Shetlander, Peter, landed and climbed to the summit of the island, a height of some 200 feet. It proved to be a mass of basalt. The scene was desolate, but very grand. Below them lay the ship anchored to the floe, and far away in the distance the walrus boats could be seen. To the north was the coast of land to the west of McClintock Island, sinced named after Sir Joseph Hooker, enveloped in mist, with loose ice floating through the intervening strait. It was calm, and all was still until the silence was broken by the ivory gulls (*Pagophila eburnea*) which Peter had disturbed on their nests. Seven of them were taken alive, of which one survives, and is now in the Zoological Gardens. They had built near the top of a low basaltic cliff, and the young ones were tilted out of their nest on the snow beneath. On this island there was a quantity of driftwood, and one very large stem of a tree. During the day seventeen walruses were captured, and many more might easily have been taken.

* * * * * * * * *

Eira Harbor, 80° 4′ N. Lat., 48° 40′ E. Long., August 20, 1880.

In the morning of the 20th three bears were seen on the shore, a mother and two cubs, slowly wandering about and sniffling the sand. An empty box had been left on shore, and they were seen walking round and examining it. They did not seem to take any notice of the ship. The plan of attack was soon arranged. Two boats were lowered, one remaining to the left of the bears a little off shore, while the other rowed away to land the attacking party at some distance. After landing, the assailants walked towards the bears, and, as their backs were turned, they easily got pretty close. As soon, however, as they saw their enemies, all three bears made a rush to the water. This sealed their fate. They were doomed, the mother to death, and her two children to an aimless life of inactivity at the Zoological Gardens. The two boats closed in; a shot through the head ended the life of the mother and saved her from witnessing the degrading spectacle which followed. The men made quick work of the affair. The boats closed in with the young bears between them, and in very short time each boat had a bear to tow it back to the ship.

* * * * * * * * *

Lat. 80° N., Long. 52° E, Aug. 21.

In returning, an attempt was made to secure a young walrus alive. But the mother fought frantically, and guarded her offspring with such resolution that they were obliged to kill her, when the young one immediately decamped. Directly the mother is shot dead, the baby walrus always hurries away, but so long as the mother is alive, even if wounded, the young one remains by her. In this case there was a hard fight, and the boat reached the ship in a sinking condition, the walrus having made holes in it with her tusks, below the water line.

After this little episode, the *Eira* was steered westward along the coast, towards the most distant point seen from the harbour. But she was stopped by packed ice at a point where there were great numbers of loons.

* * * * * * * * *

Mr. Grant walked along the shore to the eastward until finally stopped by a glacier. There was a regular beach, and a good deal of drift-wood, including a spar 8 feet long, which had evidently belonged to some ship. There were also the backbones and jaws of two whales. In the evening a party accompanied Mr. Grant to the summit of the hill overhanging the harbour, which proved to be 1040 feet above the sea (by aneroid). On the slope of this hill a good deal of petrified wood was collected, and some other fossils.

* * * * * * * * *

Lat, 80° N., Long. 50° E., Guenther Bay.

On the 26th and 27th a furious gale was blowing brom the N.N.W. with much snow; and on the 28th, when it was still strong, but moderating, they steamed slowly eastward along the coast. In passing out of the bay, two right whales were seen, one of great size.

Commenting upon the results of Mr. Smith's voyage, Mr. Northam, in the March "Proceedings of the Royal Geographical Society," says:

Arctic exploration is distinguished not only for the variety and importance of its scientific results, but also for its practical utility. It has not only added to the sum of human knowledge, but it has also increased the wealth of those nations which have wisely engaged in it. The explorers of Hudson's Bay led the way to a lucrative fur trade; those of Spitzbergen, of Davis Strait, and Baffin's Bay opened up other great sources of wealth; and the discoverers of New Siberia enriched their countrymen by a trade in fossil ivory. Mr. Leigh Smith, in discovering the south-western coast of Franz-Josef Land, saw at least two right whales, and a sea abounding in other oil-yielding animals. As many as twenty-seven walruses were taken, and, if their capture had been the object of the voyage, many more could have been obtained. Great numbers of seals were also seen. The number of bears shot was thirteen. Like all other northern discoveries, those of Mr. Leigh Smity combine results of scientific interest and importance with practical utility.

It is not at all unlikely that the practical utility of Mr. Leigh Smith's discoveries may be demonstrated in the near future. The Norwegians have now been frequenting the walrus grounds of Spitzbergen and Novaya Zemlya for a considerable number of years, and there are distinct signs of those localities having been overworked. The hardy Norseman will eagerly welcome a new region for walrus hunting, such as is offered by the southern shores of Franz-Josef

Land; and even whalers may not improbably follow in the same direction. The only difficulty which may cause them to hesitate is the supposed obstruction of the approach, by ice floes. Explorers, by annual reconnaissances, will throw a flood of light on that question, and, as in so many other instances, Arctic discovery will prove to be not only important in increasing the sum cf human knowledge, but also in opening up new sources of commercial industry.

The following letter of Gen. Washington is in possession of a gentleman living at Mendon, Chariton Co., Missouri:

MOUNT VERNON, April 22, 1789.

SIR:—I received this day by the Free Mason, Capt. Lawrence Layton, four tierces and three barrels of seed which were notified by a letter you were so obliging as to forward by last stage. I beg leave in behalf of my Uncle to offer many thanks for your care of and dispatch in forwarding them—as the freight agreed upon was not specified and the Captain informed me that you would settle it, will thank you by the first stage to inform me the amount and any other charges that may have arisen from its transportation and the money shall be immediately remitted to you.

I am Sir, Your Obedient Humble Servant,

GEORGE WASHINGTON.

RICHARD CURRAN, ESQ.

THE FIRST REGULAR MEETING OF THE NEW MEXICO SOCIETY.

At the first regular meeting of the New Mexico Historical Society, composed of the most influential and prominent officials and citizens, the president, Acting-Governor W. G. Ritch, made an able and exhaustive address, reviewing the objects of the society, outlining the ancient history of the territory and calling special attention to the three-century-old palace dating from the earliest existence of the Spanish colonists in New Mexico. He recommended, and a memorial is being prepared and extensively signed praying Congress for a charter, and asking that this ancient historical relic, the oldest in the United States, be granted to the society for preservation in the interest of the whole country, the society being national in its scope and embracing the oldest and most prolific fields of historical research.

EDITORIAL NOTES.

THE present number completes the fourth volume of the *Review*, and we again express our sense of obligation to our subscribers, and especially those in this city, for their generous sympathy and support. To the liberality of the latter class we attribute the unusual success that has attended our efforts to build up a magazine which should be a credit to the people of the West and a suitable medium for disseminating their theories, discoveries and inventions. Of course the fact that such a journal thrives in any community is a guaranty to the world that the taste and enterprise of that community are of a high order and has its full weight in attracting persons of similar tastes and spirit to make it their home and field of labor.

The fifth volume begins with the May number and we hope to receive enough additional subscribers to place the *Review* on an independent basis, pledging ourselves to improve it in every respect at a rate commensurate with its patronage.

As heretofore, we will bind the volume just closed in good, handsome binding, half morocco with cloth sides, for one dollar. All subscribers desiring this or any of the preceding volumes bound, will please send in their back numbers as soon as possible, either to this office or to the counting-room of Ramsey, Millett & Hudson.

Missing numbers of the third and fourth volumes supplied at current rates. Those for the first and second volume supplied gratis, or full sets at $1.25 per volume unbound, or $2.25 bound.

On the 29th ult. occurred the March meeting of the Kansas City Academy of Science. The feature of the evening was a second paper on "The Future Drainage of Kansas City," by Mr. Robert Gillham. In his first paper Mr. Gillham pointed out the mistakes made in early sewerage in London, Boston, New York and Chicago, which, having increased the death-rate by not meeting the sanitary conditions, were subsequently rectified, entailing a heavy loss on those cities. In his second paper he proposed a system of drainage for Kansas City which he claims will meet the necessities of the city, however large its population may become. Mr. Gillham's system proposes radical modifications of the present plan.

The Academy voted to publish the papers in pamphlet form, for the thoughtful consideration of the people of Kansas City.

The secretary called attention to the recent exploration of the Beni river, in South America, by Dr. E. R. Heath. He said these discoveries would be recognized by Geographical Societies everywhere, and modify all our maps of that country.

WE are requested by Mr. Sidney Hare, curator of the Kansas City Academy of Science, to inform all persons who have geological, mineralogical, archæological or any other specimens of value or interest to donate to its museum, that he will promptly respond to a notice of any kind and call for them. He will put them in order, label them, and place them in secure cabinets, where they can be seen by the public, but preserved carefully.

THE project of the removal of the Morrison Observatory from Glasgow to this city meets with more favor than was expected when the suggestion was made by Dr. Lewis, who is a relative of Miss Morrison, the donor of the funds with which the Observatory was built and equipped. There are several wealthy gentlemen here whose education and inclinations would prompt them to contribute liberally to such a purpose, were it found to be feasible. Twenty-five thousand dollars is estimated to be ample for the carrying out of the scheme; an amount that could be raised in one day if necessary, and we should then have an institution which would be an honor to the city, as the work of its astronomers is now a credit to the West. As one of the departments of a University to be built up here it would have a world-wide reputation to start with.

IN common with many other scientific magazines of the country, we shall hereafter devote a portion of our space to "Notes and Queries," to which department we invite contributions on all appropriate subjects by our subscribers and interested readers.

A RECENT visit to Washington University, at St. Louis, and a careful inspection of its ample, complete and modern buildings, apparatus, and appliances for illustrating and teaching, not only the ordinary branches of education, but natural philosophy, chemistry, technology, painting and sculpturing, convinced us that in many of these departments it is not equaled in the West, and that it is excelled in none. In the departments of physics and practical engineering it is especially strong, the students being put to the actual work of doing with their own hands the experimenting with fluids, solids, metals, etc., the architectual drawing, the construction of models in wood for castings, the forging of tools, etc., which he expects later in life to use and to deal with. Everything is practical, even in the art department and the geological cabinet. If even the people of St. Louis themselves generally know what a valuable Institution they have in their midst, which is doubtful, it is far more than the people of the State do, much as they need such an one for the education of experts to aid in developing the inestimable wealth of its mines and its immense natural resources of every kind.

WE are informed that Mr. Chas. Sternberg, of Ellsworth, with a son of Dr. Reynolds, of Riley, as assistant and a driver, are collecting Kansas fossils for Prof. Agassiz, of Harvard College, Mass. They started March 1st and are now collecting among the fossil leaf impressions of the Dacotah group, a division of our Cretaceous. They work first in Western Kansas, and, if time allows, they will this fall collect a full set of coal fossils, also.

WORK upon the tunnel under the Hudson river, connecting the cities of New York and Jersey City, is being pushed forward at the rate of about five feet a day. A small tunnel six feet in diameter is run ahead of the larger one, which follows and incloses it. Warning is thus given of the nature of the soil.

A DISTANT subscriber to the REVIEW in a private letter writes as follows concerning Col. Van Horn's article in the February number: "I have been waiting for years for some one to utilize Prof. Crook's radiant light, and has not Mr. Van Horn done it well in his "New Hypothesis? I can follow him with deep interest through the larger portion of the article, but once in a while he dives so deep that I have to leave him in the depths. I am almost tempted to visit Kansas City to see him and get more light."

MR. EMIL POURADE has discovered what he believes to be a quarry of very fine lithographic stone, on the Big Blue, about five miles east of this city.

REV. DR. BELL gives the following complimentary notice of the REVIEW in a late number of the *Mid-Continent:* "The articles are numerous and exceedingly well written and chosen. The article by our President of the Academy of Science, Hon. R. T. Van Horn, which leads the whole list, is one of rare merit. The way to make this work a still greater success in all directions, is to buy it, subscribe for it."

AT the close of the ceremonies attending the formal presentation of the obelisk to the City of New York, Algernon S. Sullivan, Esq., on behalf of the American Numismatic and Archæological Society, formally presented to Lieutenant-Commander Gorringe a medal, which the Society had caused to be struck in commemoration of the event. The medal bore the following inscription: "Presented to the United States by Ismail, Khedive of Egypt, 1881. Quarried at Syene and erected at Heliopolis by Thothmes III. Re-erected at Alexandria under Augustus. Removed to New York through the liberality of W. H. Vanderbilt, by the skill of Lieutenant-Commander H. H. Gorringe, U. S. N."

FOR the first time in the history of the Franklin Institute a woman has delivered a course of lectures there. Professor Rachel Bodley, of the Women's Medical College of Pennsylvania, was the lecturer, and she gave a course of six lectures on "Chemistry, as applied in the household." They were largely attended.

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY, edited by Theo. S. Case, presents an extensive array of general scientific information, clearly and concisely put, the most recent developments and latest movements in that line of progress upon which we base great hopes for the future. It is now running upon the fourth volume, and may be said to be an established institution. —*Boston Post.*

The great event of the year in this section was the completion of the second trans-continental line to the Pacific by the connecting of the Atchison, Topeka & Santa Fe Railroad and the Southern Pacific Railroad at Tucson. On the 17th of March the first through passenger train for California, by this route, left the Kansas City Union Depot.

PROF. CLARENCE KING has resigned the position of Chief of the U. S. Geological Survey, and the president has appointed as his successor, Major S. W. Powell, the well known explorer of the western mountains, the Colorado river, etc.

PROF. JNO. D. PARKER, of this city, has recently invented and patented a gauge for the accurate setting of compositors' sticks to different "ems," which will prove a useful and convenient aid to printers in preserving that uniformity in the width of columns which is indispensable to the proper locking up of forms. It is a simple and cheap device which every printer should have.

WE take pride anticipating all other journals in announcing the valuable discoveries recently made by Dr. Heath in South America. The exploration of the Beni river has hitherto defied all effort, but Dr. Heath has accomplished this result, so long desired, unaided. He will hereafter be counted among the noted explorers of South America. His brief letter in another column will prove of general interest.

ITEMS FROM THE PERIODICALS.

The New York *Tribune* says: "The ravages of a parasitic insect on orange and lemon trees are attracting much attention in Italy and the West Indies, and have begun to create alarm in Florida, Louisiana and California. J. H. Bostwick, Inspector of Customs, who has charge of the Fruit Department of the New York Custom House, is taking great interest in the matter, and has some specimens from cargoes of oranges, the rinds of which are covered with incrustations of these parasites."

Since observing the above, we have been shown by Mr. John H. Ramsey of this city, an orange with an incrustation answering to the above description. The general shape of these parasites is similar to the *Hemipronites Crassus* and its dimensions about three lines in length and one line in diameter at the larger end.

THE *Journal of the Franklin Institute*, for March, comes to us with a supplement equivalent to sixty pages, being the plates to S. Dudley's artitle on "The Wearing Power of Steel Rails, in Relation to their Chemical Composition and Physical Properties." The article is the result of long study and the illustrations are very interesting and curious.

THE result of the census of 1880 shows the center of population of the United States to be within the city limits of Cincinnati, Ohio.

Good Company, for February, 1881, presents its readers, among much other entertaining matter, the first chapter of an account of Polar Expeditions, by Lieut. Schwatka, under the title of "In the Land of the Midnight Sun."

THE *United States Gazette*, Philadelphia, of November 27, 1832, contained the following notice: "The locomotive ('Old Ironsides') built by Mr. Baldwin, of this city, will depart daily *when the weather is fair*, with a train of passengers. On rainy days horses will be attached."

OF the various college periodicals we find find none handsomely printed, better edited or more entertainingly contributed to than the *Olio*, of Marietta College, Ohio. Its *Personalia* are especially interesting to the *alumni* of the institution. It is now in its ninth volume. Monthly, $1.50.

THE *Nationalist*, of Manhattan, Kansas, sends us a handsome pamphlet, entitled "The Blue Ribbon County," being a full and careful description of Riley county, its people, educational advantages, natural reresources, products, etc., which immigrants looking westward might procure and profitably read, as we believe that it contains nothing but facts, and very attractive ones, too.

MR. HENRY B. DAWSON, editor of the *Historical Magazine*, of New York, desires copies of reports, papers, tracts, etc., relating to the geology and natural history, geography and topography, aboriginal history and languages, and the antiquities of America, or anything that will throw light upon any of them. The *Historical Magazine* stands very high among periodicals of its class and the material furnished its editor on this call will be carefully and properly handled and used.

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Hon ... Burr

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